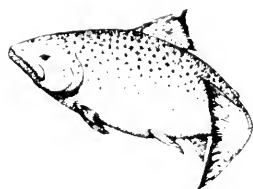
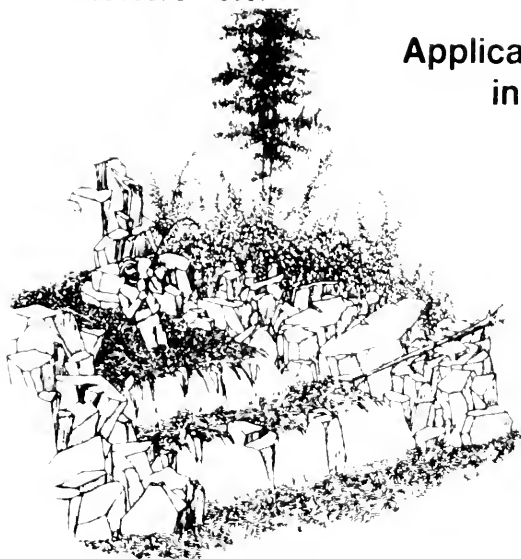


Application for Reservations of Water in the Missouri River Basin above Fort Peck Dam

STATE DOCUMENTS COLLECTION

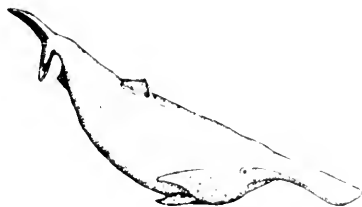
NOV 2 1981

MONTANA STATE LIBRARY
1515 F. AVE.
HELENA, MONTANA 59610



Volume 2

Reservation Requests for Waters
above Canyon Ferry Dam



JUL 1968

131

MAR 18 2001

MONTANA STATE LIBRARY
S 346 .0432 F2arwm 1969 c 1 v 2
Application for reservations of water in

3 0864 00069613 1

APPLICATION FOR RESERVATIONS OF WATER
IN THE MISSOURI RIVER BASIN
ABOVE FORT PECK DAM

VOLUME 2

Reservation Requests for Waters
Above Canyon Ferry Dam

Submitted By:

Montana Department of Fish, Wildlife and Parks
1420 East Sixth Avenue
Helena, MT 59620

June 1989

INTRODUCTION

Volume 2

This is volume 2 of a 3 volume application for reservations of water in the Missouri River Basin submitted to the Board of Natural Resources and Conservation. Legislation in 1987 authorized the reservation process in the basin from the headwaters to Fort Peck Dam. This volume covers the Missouri Basin between its headwaters and Canyon Ferry Dam (Figure 2-1).

This volume contains information on each stream in this portion of the basin for which a reservation is requested. Information presented includes a brief description of the stream or stream reach, the associated fisheries and wildlife resources, and the flow levels needed to maintain these resources. The methods and data used in arriving at the requested flows are also briefly discussed. Streams are presented in a downstream order by sub-basin.

Volume 1 contains the Summary, Purpose, Need, Amount (including details of methods used), Public Interest information and a Management Plan as required by ARM 36.16.104 through 36.16.106. Volume 3 is similar to volume 2 but covers streams in the Missouri River Basin between Canyon Ferry Dam and Fort Peck Dam.

An alphabetical index to streams in this volume begins on page 2-3.

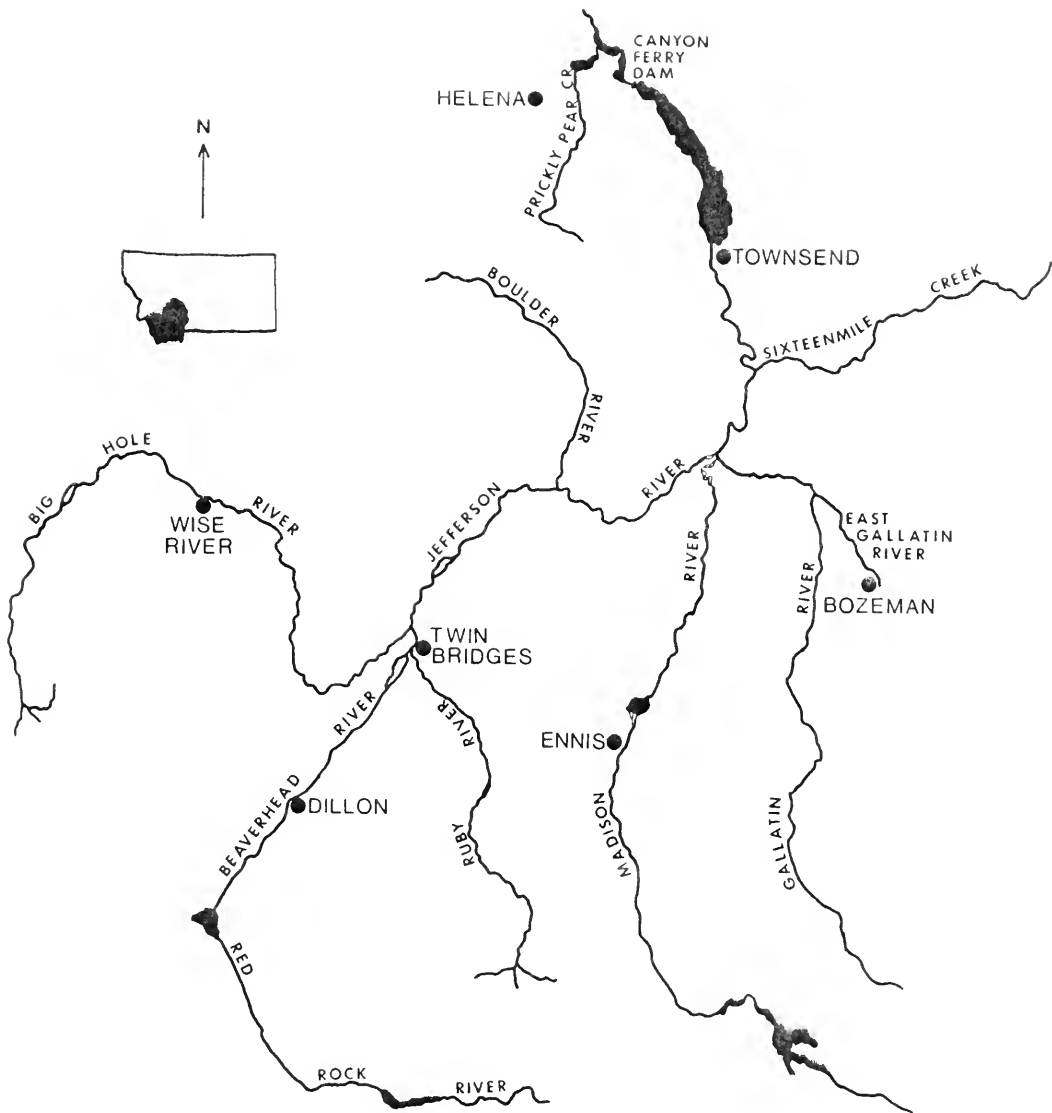


Figure 2-1. Map of the Missouri River Basin upstream from Canyon Ferry Dam.

TABLE OF CONTENTS

	Page
DESCRIPTION OF THE MISSOURI RIVER BASIN ABOVE CANYON FERRY DAM . . .	2-8
BIG HOLE RIVER SUB-BASIN	2-182
Map of the Big Hole River Sub-Basin	2-183
Map of the streams on the Mt. Haggin Wildlife Management Area .	2-184
American Creek	2-282
Bear Creek	2-298
Big Hole River	2-185
Big Hole River - Reach #1	2-187
Big Hole River - Reach #2	2-190
Big Hole River - Reach #3	2-194
Big Lake Creek	2-212
Birch Creek	2-340
Bryant Creek	2-301
California Creek	2-286
Camp Creek	2-332
Canyon Creek	2-321
Corral Creek	2-266
Deep Creek	2-294
Delano Creek	2-314a
Divide Creek	2-318
Fishtrap Creek	2-251
Francis Creek	2-214
French Creek	2-290
Governor Creek	2-202
Jacobson Creek	2-304
Jerry Creek	2-315
Johnson Creek	2-237
Joseph Creek	2-226
LaMarche Creek	2-254
Miner Creek	2-209
Moose Creek	2-324
Mussigbrod Creek	2-240
North Fork Big Hole River	2-243
Oregon Creek	2-275
Pattengail Creek	2-308
Pintlar Creek	2-247
Rock Creek	2-211a
Ruby Creek	2-233
Sevenmile Creek	2-260
Seymour Creek	2-257
Sixmile Creek	2-278
South Fork Big Hole River	2-198
Steel Creek	2-218
Sullivan Creek	2-272
Swamp Creek	2-222

BIG HOLE RIVER SUB-BASIN (Continued)	Page
Tenmile Creek	2-263
Trail Creek	2-229
Trapper Creek	2-328
Twelvemile Creek	2-269
Warm Springs Creek	2-206
Willow Creek	2-336
Wise River	2-311
Wyman Creek	2-306
GALLATIN RIVER SUB-BASIN	2-477
Map of the Gallatin River Sub-Basin	2-478
Baker Creek	2-532
Ben Hart Spring Creek	2-567
Big Bear Creek	2-525
Bridger Creek	2-543
Cache Creek	2-490
East Fork of Hyalite Creek	2-551
East Gallatin River	2-569
East Gallatin River - Reach #1	2-570
East Gallatin River - Reach #2	2-573
East Gallatin River - Reach #3	2-577
Gallatin River	2-479
Gallatin River - Reach #1	2-481
Gallatin River - Reach #2	2-484
Gallatin River - Reach #3	2-489
Hell Roaring Creek	2-515
Hyalite Creek	2-554
Hyalite Creek - Reach #1	2-555
Hyalite Creek - Reach #2	2-558
Middle Fork of the West Fork Gallatin River	2-501
Porcupine Creek	2-497
Reese Creek	2-561
Rocky Creek	2-536
Sourdough (Bozeman) Creek	2-539
South Cottonwood Creek	2-528
South Fork of Spanish Creek	2-517
South Fork of the West Fork Gallatin River	2-504
Spanish Creek	2-521
Squaw Creek	2-511
Taylor Fork of the Gallatin River	2-493
Thompson Spring Creek	2-565
West Fork of the Gallatin River	2-507
West Fork of Hyalite Creek	2-547
JEFFERSON RIVER SUB-BASIN	2-343
Map of the Jefferson River Sub-Basin	2-344
Boulder River	2-362
Boulder River - Reach #1	2-363
Boulder River - Reach #2	2-367
Boulder River - Reach #3	2-370

JEFFERSON RIVER SUB-BASIN (Continued)

Page

Halfway Creek	2-354a
Hells Canyon Creek	2-349
Jefferson River	2-345
Little Boulder River	2-358
North Willow Creek	2-381
South Boulder River	2-373
South Willow Creek	2-377
Whitetail Creek	2-355
Willow Creek	2-385
Willow Spring Creek	2-353

MADISON RIVER SUB-BASIN 2-389

Map of the Madison River Sub-Basin	2-390
Antelope Creek	2-434
Beaver Creek	2-430
Black Sand Spring Creek	2-406
Blaine Spring Creek	2-455
Cabin Creek	2-426
Cherry Creek	2-473
Cougar Creek	2-411
Duck Creek	2-413
Elk River	2-436
Grayling Creek	2-415
Hot Springs Creek	2-469
Indian Creek	2-452
Jack Creek	2-459
Madison River	2-391
Madison River - Reach #1	2-393
Madison River - Reach #2	2-396
Madison River - Reach #3	2-399
Madison River - Reach #4	2-402
Moore Creek	2-463
North Meadow Creek	2-465
O'Dell Spring Creek	2-457
Red Canyon Creek	2-420
Ruby Creek	2-449
South Fork of the Madison River	2-408
Squaw Creek	2-446
Standard Creek	2-443
Trapper Creek	2-424
Watkins Creek	2-422
West Fork of the Madison River	2-438

RED ROCK-BEAVERHEAD RIVER SUB-BASIN 2-11

Map of the Red Rock-Beaverhead River Sub-Basin	2-12
Map of a portion of the Horse Prairie Creek drainage	2-13
Bear Creek	2-84
Beaverhead River	2-103
Beaverhead River - Reach #1	2-105
Beaverhead River - Reach #2	2-110

RED ROCK-BEAVERHEAD RIVER SUB-BASIN (Continued)	Page
Big Sheep Creek	2-66
Black Canyon Creek	2-71
Blacktail Deer Creek	2-137
Bloody Dick Creek	2-90
Browns Canyon Creek	2-94
Cabin Creek	2-56
Corral Creek	2-23
Deadman Creek	2-63
East Fork Blacktail Deer Creek	2-133
East Fork Clover Creek	2-50
East Fork of Dyce Creek	2-117
Frying Pan Creek	2-77
Grasshopper Creek	2-122
Hell Roaring Creek	2-20
Horse Prairie Creek	2-99
Indian Creek	2-53
Jones Creek	2-40
Long Creek	2-46
Medicine Lodge Creek	2-96
Narrows Creek	2-31
Odell Creek	2-36
Peet Creek	2-43
Poindexter Slough	2-127
Rape Creek	2-87
Red Rock Creek	2-27
Red Rock River	2-14
Red Rock River - Reach #1	2-15
Red Rock River - Reach #2	2-17
Reservoir Creek	2-120
Shenon Creek	2-74
Simpson Creek	2-60
Tom Creek	2-33
Trapper Creek	2-81
West Fork Blacktail Deer Creek	2-130
West Fork of Dyce Creek	2-114
 RUBY RIVER SUB-BASIN	 2-141
Map of the Ruby River Sub-Basin	2-142
Coal Creek	2-153
Cottonwood Creek	2-167
East Fork Ruby River	2-159
Middle Fork Ruby River	2-155
Mill Creek	2-176
North Fork of Greenhorn Creek	2-173
Ruby River	2-143
Ruby River - Reach #1	2-144
Ruby River - Reach #2	2-149
Warm Springs Creek	2-170
West Fork Ruby River	2-173
Wisconsin Creek	2-179

UPPER MISSOURI RIVER SUB-BASIN	2-580
Map of the Upper Missouri River Sub-Basin	2-581
Avalanche Creek	2-613
Beaver Creek	2-609
Confederate Gulch	2-605
Crow Creek	2-591
Deep Creek	2-598
Dry Creek	2-595
Duck Creek	2-602
Missouri River - Reach #1	2-582
Sixteenmile Creek	2-587
REFERENCES	2-616

DESCRIPTION OF THE MISSOURI RIVER BASIN ABOVE CANYON FERRY DAM

The headwater tributaries in the 15,904 square-mile portion of the Missouri River Basin above Canyon Ferry Dam, referred to as the upper basin in this application, have their origins in the snow fields of some of western America's wildest mountain ranges. Vast tracts of publicly-owned forest and range lands, wildlife areas and parks dominate this mountain landscape. The jewel of the public domain is Yellowstone National Park, located at the headwaters of the Madison and Gallatin rivers. Beyond the mountains, the snow melt continues on its downstream journey, flowing through semi-arid valleys supporting sagebrush, grasses and irrigated hay and grain crops before reaching Three Forks, where the Madison, Jefferson and Gallatin rivers meet and give birth to the Missouri River.

Bozeman is the largest city in the upper basin, with 30,000 people in the greater Bozeman area, including 11,000 students at Montana State University. Smaller communities include Townsend, Ennis, West Yellowstone, Gallatin Gateway, Manhattan, Three Forks, Big Sky, Dillon, Twin Bridges, Sheridan and Virginia City. Agriculture and tourism are the mainstays of the area's economy. Other contributors are the timber, mining and light manufacturing industries, the university system and various state and federal agencies, which employ a variety of disciplines.

About four million acre-feet of water, excluding depletions to irrigate an estimated 560,000 acres, flow from the upper basin each year. About 75% of this flow originates from snowpack deposited on the slopes of the upper basin's mountain ranges. In spring, rains and warming temperatures begin releasing this winter moisture into the network of small tributaries that drain the high peaks.

Above Canyon Ferry Dam, four major reservoirs regulate flow: Clark Canyon Reservoir on the Beaverhead River, Ruby Reservoir on the Ruby River and Lima Reservoir on the Red Rock River - all of which are irrigation storage projects - and Hebgen Reservoir on the Madison River, built by the Montana Power Company to store water for downstream hydroelectric production. Other major dams are Ennis Reservoir on the Madison River and Toston Reservoir on the mainstem Missouri. Hydropower is currently generated at Ennis Dam and is slated for future production at Toston Dam.

The recreational opportunities afforded by the upper basin, particularly the trout fishing, are nationally acclaimed, attracting tourists from throughout the nation who provide a significant boost to Montana's economy. Anglers alone spent an estimated \$31.6 million in 1985 while fishing the trout waters of the upper Missouri basin. The upper basin contains over 436 miles of Class I (blue ribbon) and II (high value) stream fisheries, all sustained entirely by trout produced in the wild. Among this select group is the world renowned Madison River, long considered Montana's premier stream fishery.

In 1985, over 595,000 angler-days of recreation were expended on upper basin waters, with non-residents of Montana accounting for 227,000 angler-days. The fact that 43% of all non-resident fishing pressure in Montana occurs in the upper Missouri basin is a tribute to the outstanding quality of the area's valuable fishery resources.

An added attraction is the upper basin's diverse wildlife populations, which contribute significantly to the area's reputation as an outdoor paradise. Mule and whitetail deer, elk, pronghorn antelope and black bear are a popular quarry of both resident and non-resident hunters. The upper basin supports some of the highest elk densities in western North America. Montana's lengthy elk hunting season, the longest in the nation, attests to the high quality of this resource. Lesser numbers of other big game animals, including moose, bighorn sheep, mountain lions, bison and mountain goats, also occur in huntable populations. Furbearers from the common mink, muskrat and beaver to the more exotic lynx, bobcat, river otter and wolverine are upper basin residents, along with a variety of game birds and waterfowl, including the once endangered trumpeter swan. A myriad of non-game species, including raptors such as golden eagles, prairie falcons and ospreys, are also present. Among the wildlife inhabitants of the upper basin are four federally designated endangered or threatened species, and two fishes classified by the MDFWP as Class A species of "special concern." These are:

Bald Eagle

The bald eagle, federally classified as an endangered species, occurs year-round in the upper Missouri basin. The upper basin's breeding population continues to increase, with 13 nesting pairs presently documented. From 30-50 eagles winter on area reservoirs and rivers. Winter densities are typically highest in the area of Ennis Reservoir on the Madison River and along the headwaters of the Missouri River near Three Forks, where 12-15 eagles may be present at each location. Bald eagles commonly pass through the upper basin during fall and spring migrations.

Peregrine Falcon

The peregrine falcon, also endangered, occurs as a casual migrant in the upper Missouri basin in spring and fall. Recent efforts to re-introduce peregrines to former breeding range in the upper basin are proving successful. Three breeding pairs are presently established and more are anticipated in the near future.

Whooping Crane

Two sub-adult whooping cranes from the Grays Lake flock in northern Idaho, established to re-introduce cranes to former range, have summered on the Red Rock Lakes National Wildlife Refuge in recent years. The whooping crane is a federally designated endangered species.

Grizzly Bear

Grizzly bears, designated as threatened by the Federal Government, use the mountain wildlands of the Madison, Gallatin and Ruby river drainages yearlong for winter denning, feeding and day-bedding from February through

November, and as a travel corridor. Less than 500 bears remain in the Greater Yellowstone Ecosystem, which encompasses lands within the upper Missouri basin.

Westslope Cutthroat Trout

Originally, the westslope cutthroat trout was the only trout living in Montana's Missouri River basin. They have been displaced from much of their former range by introduced fishes, and many of the remaining populations have been genetically contaminated through hybridization with rainbow trout and Yellowstone cutthroat trout, non-natives in the Missouri system. Loss of habitat through stream bank destruction, dewatering, in-channel sedimentation and degraded water quality has also contributed to their decline. Today, genetically pure cutthroat in the Missouri basin are generally restricted to headwater areas of mountain tributaries where they survive in isolated populations numbering from a few hundred to a few thousand individuals.

Arctic Grayling

In the lower 48 states, the arctic grayling is native to Michigan, where it is now extinct, and to the upper Missouri drainage above the Great Falls. Today, Montana's remaining stream-dwelling, or fluvial, grayling are found only in the Big Hole River and some of its tributaries, and perhaps 10 other streams where introductions have occurred. Population levels remain very low and continue to decline. At present, grayling strongholds on the mainstem Big Hole support less than 100 adults per river mile. Habitat destruction and competition from introduced species have been cited as the main causes for their continuing decline.

RED ROCK-BEAVERHEAD RIVER SUB-BASIN

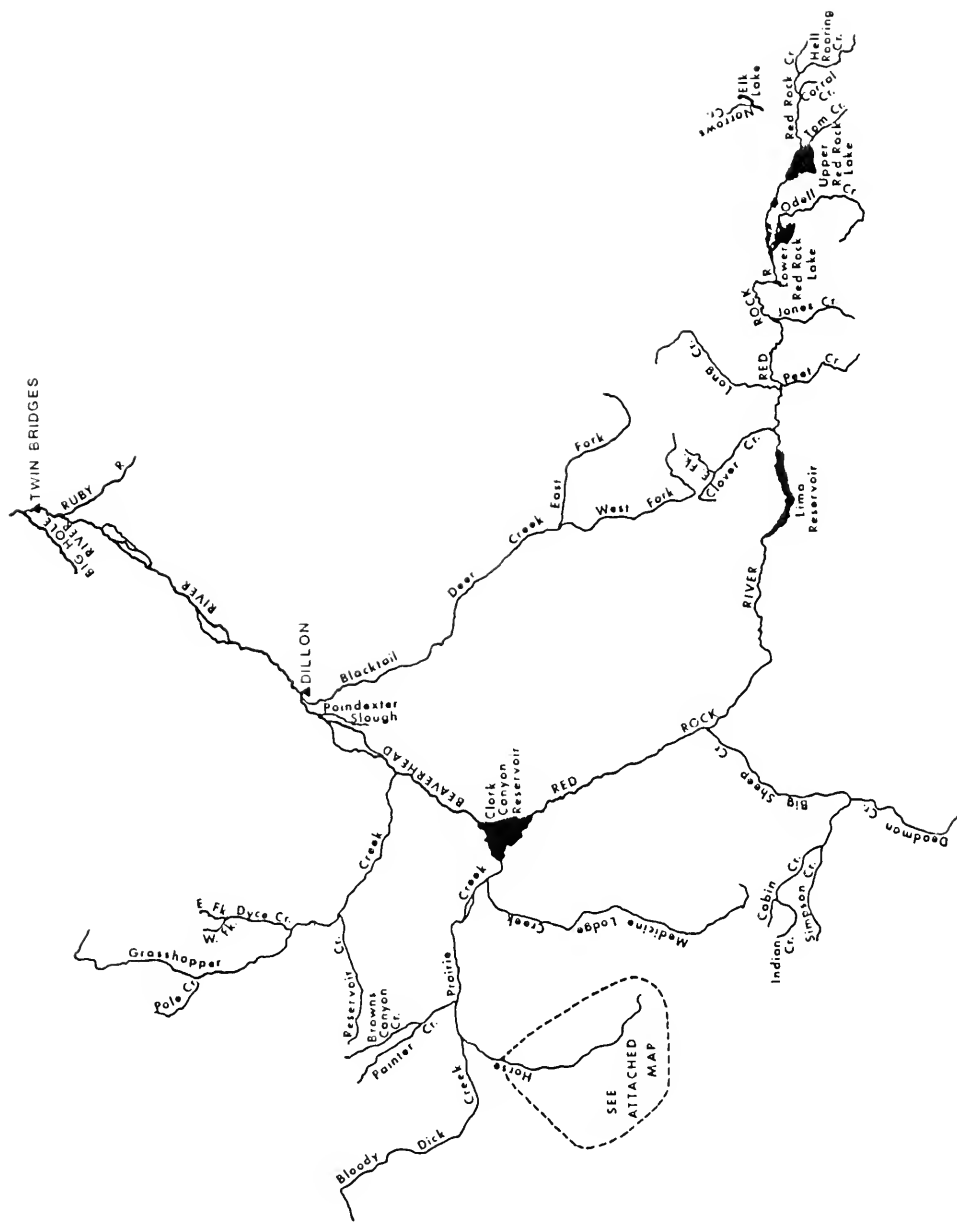


Figure 2-2. Map of the Red Rock-Beaverhead River Sub-Basin.

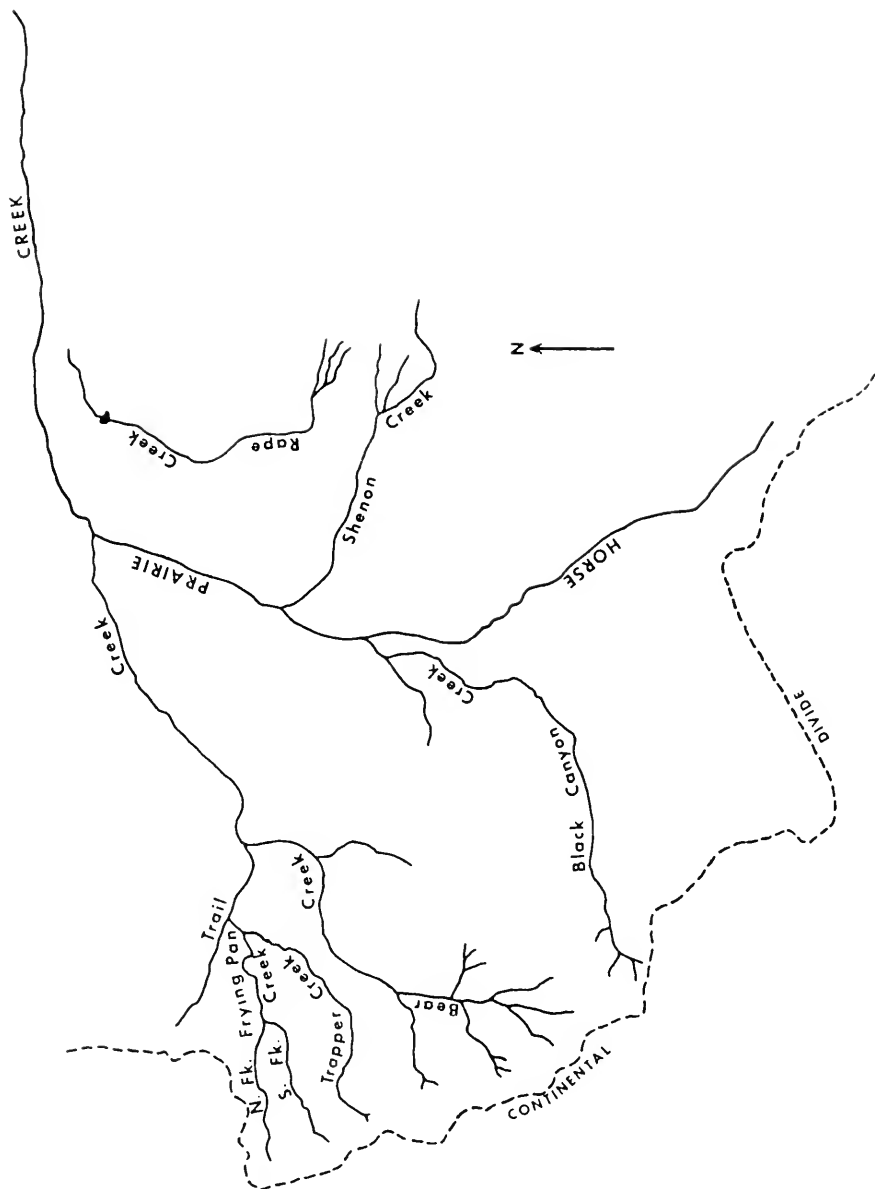


Figure 2-3. Map of a portion of the Horse Prairie Creek drainage.

STREAM NAME: Red Rock River

GENERAL DESCRIPTION OF BASIN:

The Red Rock River originates at the outlet of Lower Red Rock Lake in the Centennial Valley of southwest Montana. Three large bodies of water - Upper and Lower Red Rock and Swan Lakes - lie in the headwater area and constitute the Red Rock Lakes National Wildlife Refuge. From the lower lake, the river slowly meanders westward for 29.3 miles through open sagebrush country before entering, at the lower end of the Centennial Valley, Lima Reservoir - a 6,800 acre irrigation storage facility built in 1902. From Lima Dam, the river flows an additional 57.4 miles in a northwesterly direction through agricultural and grazing lands before discharging into Clark Canyon Reservoir - a 4,900 acre irrigation storage impoundment. Before Clark Canyon Reservoir was completed in 1964 and inundated the juncture, the Red Rock River and Horse Prairie Creek converged to form the Beaverhead River. The Red Rock River drains an area of 1,580 square miles, about half of which lies on the mountain slopes of the Continental Divide.

STREAM NAME: Red Rock River

STREAM REACH: #1. From the dam at Lower Red Rock Lake to Lima Reservoir-
29.3 miles

LOCATION: Sec. 6, T14S, R2W to Sec. 6, T14S, R4W

DESCRIPTION OF STREAM REACH:

Reach #1 of the Red Rock River slowly meanders at a low gradient for 29.3 miles through open sagebrush country within the Centennial Valley. Here, the river has a sand-gravel bottom that is covered in vast areas with accumulations of silt. The narrow riparian zone is vegetated with sedges, grasses and clumps of willow. Over half of this reach passes through parcels of public land controlled by the BLM, State of Montana and U.S. Fish and Wildlife Service. The summer grazing of livestock is the major land use along this stretch.

A USGS gage at river mile 10.4 of Reach #1 was operated from 1936-67. The mean annual flow for the 6 complete years of record (1937-42) was 93.6 cfs. For the remaining period (1942-67), only non-winter flows were recorded. Non-winter mean monthly flows ranged from 47.1 cfs (for September) to 408 cfs (for May). Water to irrigate about 6,000 acres is diverted above this site. The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for Reach #1 at about 130,200 acre-feet (180 cfs).

GAME FISH PRESENT: Brook trout, cutthroat trout, mountain whitefish, arctic grayling.

FISHERY:

Reach #1 of the Red Rock River supports brook trout, cutthroat trout, mountain whitefish and a few arctic grayling, which are probably drifters from the Red Rock Lakes. Other fish present include burbot, mottled sculpin and longnose and common sucker. While this reach is not noted for supporting an abundant trout population, it does produce some larger size trout. Brook trout longer than 16 inches and cutthroat trout of 3-4 pounds are reportedly caught by anglers. The magnitude of these populations has not been quantified using electrofishing procedures.

Use of Reach #1 as a reproductive site for the game fish population of Lima Reservoir is negligible. Lima Reservoir is too warm and shallow to support significant numbers of trout. However, the reservoir provides an isolated, undisturbed area where non-breeding Canada geese and trumpeter swans gather to molt and summer. From 8,000-12,000 geese and up to 140 trumpeters are found on the reservoir each summer.

WILDLIFE:

The open, sagebrush lands along Reach #1 of the Red Rock River seasonally support antelope from spring through fall. Reach #1 is particularly noted as a waterfowl area. It produces very good waterfowl numbers during the spring-summer breeding season and provides excellent resting habitat during spring and fall migrations.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 55 cfs (39,818 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Reach #1 of the Red Rock River. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 43% of the average annual flow is being requested for those Beaverhead-Red Rock River tributaries having high fishery values. An average annual flow of 129 cfs was estimated by the USGS for the Red Rock River near Lakeview (gage #06011000). An instream flow of 55 cfs is, therefore, requested.

STREAM NAME: Red Rock River

STREAM REACH: #2. From Lima Dam to Clark Canyon Reservoir - 57.4 miles

LOCATION: Sec. 32, T13S, R6W to Sec. 29, T10S, R10W

DESCRIPTION OF STREAM REACH:

Between Lima Dam and Clark Canyon Reservoir the Red Rock River flows for 57.4 miles through privately owned valley lands primarily used for hay production and the wintering of cattle. Here, the river width averages about 45 ft at low flow and the bottom substrate is comprised of gravel-cobble, with some silt deposition in the slower moving waters. The narrow riparian zone is primarily vegetated with grasses, willows, alders and cottonwoods.

Fishing is the most important recreational activity on Reach #2. Except for a ½ mile of river at the head of Clark Canyon Reservoir, virtually all lands surrounding Reach #2 are privately owned and, thus, permission of the landowners is required to gain access. Stream dewatering can be severe in this reach, with flow ceasing for several days at a time within short stretches of river. Wintering cattle have damaged the stream banks along portions of the reach, creating raw and eroding banks.

The USGS has operated a gage at the head of Reach #2 at river mile 57.3 since 1911. The mean annual discharge for a 48-year period of record was 143 cfs. Mean monthly flows ranged from 19 cfs (for March) to 427 cfs (for June). Lima Reservoir markedly alters the natural flow regime of the Red Rock River.

A USGS gage at river mile 23 of Reach #2 was operated during the non-winter months from 1942-67. Non-winter mean monthly flows ranged from 97 cfs (for May) to 129 cfs (for July). Water to irrigate about 35,000 acres is diverted above this site.

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish.

FISHERY:

Brown trout, rainbow trout, mountain whitefish and a few brook trout comprise the resident game fish in Reach #2 of the Red Rock River. Other species present include burbot, white sucker, longnose sucker, mountain sucker, longnose dace and mottled sculpin.

A mark-recapture population estimate was conducted in June, 1974 for a 6,250 ft section of the lower river above Clark Canyon Reservoir. This section supported an estimated 209 brown trout (4.6-20.1 inches) and 36 rainbow trout (8.7-20.7 inches), weighing a total of 169 pounds, per 1,000 ft of stream. The resident trout population is fairly substantial for a river the size of the Red Rock.

More importantly, Reach #2 provides crucial spawning and rearing habitats for the trout population inhabiting Clark Canyon Reservoir - a popular fishing site that supported an estimated 21,000 man-days of angling between May, 1983 and April, 1984. A strong brown trout spawning run

annually ascends the river from about September 15 to November 15. These spawners average near 4 pounds, with fish up to 10 pounds captured during electrofishing surveys. The brown trout fishery of the reservoir is wholly maintained by the natural reproduction that occurs in the reservoir tributaries, the most notable being the Red Rock River.

In 1982, the MDFWP began a program to improve the rainbow trout fishery of Clark Canyon Reservoir by planting a wild stock of fish. Unlike the domesticated stocks planted in the past, these rainbow trout are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The spawning run that ascends the Red Rock River each spring continues to increase as the reservoir population of wild rainbow trout builds. During the 1987 run, these spawners averaged just over 3 pounds.

WILDLIFE:

Lands adjacent to Reach #2 of the Red Rock River support very good year-round populations of mule and white-tailed deer. Beaver and mink are the primary furbearers associated with the river. Reach #2 is extensively used by migratory waterfowl during spring and fall and provides fair waterfowl production (Canada geese and ducks) during the spring-summer breeding season.

WETTED PERIMETER:

Cross-sectional measurements for Reach #2 of the Red Rock River were made in a 320 ft section at about river mile 24 (Sec. 33, T12S, R9W). Five riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 87, 259 and 463 cfs.

The wetted perimeter-flow relationship (Figure 2.4) for the composite of five riffle cross-sections shows lower and upper inflection points at approximate flows of 40 and 60 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning and rearing habitats for brown and rainbow trout residing in Clark Canyon Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 60 cfs (43,438 A.F./yr)

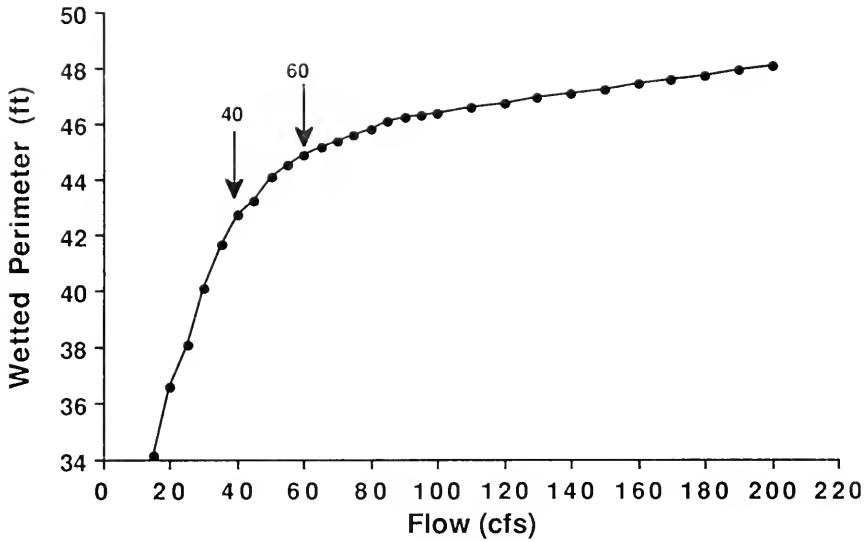


Figure 2-4. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Reach #2 of the Red Rock River.

STREAM NAME: Hell Roaring Creek

STREAM REACH: From the headwaters to the mouth - 9 miles

LOCATION: Sec. 9, T15S, R2E to Sec. 13 and 14, T14S, R1E

DESCRIPTION OF STREAM REACH:

Hell Roaring Creek originates on the northern slopes of the Centennial Mountains of southwest Montana and flows in a northwesterly direction for approximately 9 miles before entering Red Rock Creek, a tributary to Upper Red Rock Lake. At about stream mile 2, Hell Roaring Creek splits into two channels, entering Red Rock Creek at two sites. The drainage is characterized by steep, conifer-covered ridges in the upper portion and sagebrush/grassland communities in the lower portion. Control of the 9.5 square mile drainage is shared by the BLM (38%), USFS (33%), private individuals (19%) and the State of Montana (10%). The 27 ft wide channel has an average gradient of approximately 29 ft per 1,000 ft. There are no named tributaries to Hell Roaring Creek.

Lands within the Hell Roaring Creek drainage are used for cattle grazing, agricultural research and recreation in the form of hunting, fishing and hiking. Fifty percent of the BLM land is managed by the U.S. Sheep Experiment Station. The remainder lies within the boundaries of the Centennial Mountains Primitive Area.

Overgrazing of the riparian zone by cattle along portions of the stream has resulted in the loss of undercut banks and streamside vegetative cover, the widening of the stream channel and increased erosion rates.

CAME FISH PRESENT: Brook trout, cutthroat trout, arctic grayling.

FISHERY:

A resident population of arctic grayling was reported in Hell Roaring Creek in 1907 (Henshall, 1907). In 1951, a spawning run of grayling from the Red Rock Lakes was present in the lower reaches of Hell Roaring Creek (Nelson, 1954a). By September of the same year, only young-of-the-year were present, indicating that the stream provided both spawning and rearing habitats for the lake (adfluvial) population.

Peterson (1976) electrofished a 2,287 ft section of Hell Roaring Creek at about stream mile 1.0 during June and September, 1975. Game fish captured during both sampling periods were brook and cutthroat trout (Table 2-1). Large cutthroat trout were present only in June when spawning occurs. It appears that the brook trout is the dominant resident game fish in Hell Roaring Creek and adfluvial cutthroat trout residing in Upper Red Rock Lake utilize the stream for spawning and the rearing of young.

Table 2-1. Summary of electrofishing survey data collected for a 2,287 ft section of Hell Roaring Creek (T14S, R1E, Sec. 24B) in June and September, 1975.

Fish Species	Number Captured		Length Range (inches)	
	June, 1975	Sept., 1975	June, 1975	Sept., 1975
Brook trout	34	17	2.7 - 11.8	5.2 - 13.4
Cutthroat trout	14	1	13.1 - 21.2	3.7

No arctic grayling were captured during the 1975 surveys. It appears that this stream, although historically used by both resident and adfluvial grayling, is no longer suitable for this species. Barriers are apparently not the problem since Hell Roaring Creek is accessible to spawning cutthroat trout residing in the lake.

WILDLIFE:

From spring through fall the Hell Roaring Creek drainage seasonally supports populations of moose, antelope, mule deer and elk. Black bear and an occasional grizzly bear are also present. Beaver, mink and marten are the primary furbearers within the drainage. An artificial hack site was recently established in the drainage in an attempt to reintroduce peregrine falcons to the area.

WETTED PERIMETER:

Cross-sectional data were collected in a 141 ft riffle-run sequence of Hell Roaring Creek at approximate stream mile 1.0 (T14S, R1E, Sec. 24B). Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 13.5, 62.8 and 110.3 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-5. Lower and upper inflection points occur at about 8 and 15 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect important spawning and nursery habitats for cutthroat trout residing in Upper Red Rock Lake; to protect spawning and nursery habitats used by the arctic grayling population of Upper Red Rock Lake in the past; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 15 cfs (10,859 A.F./yr)

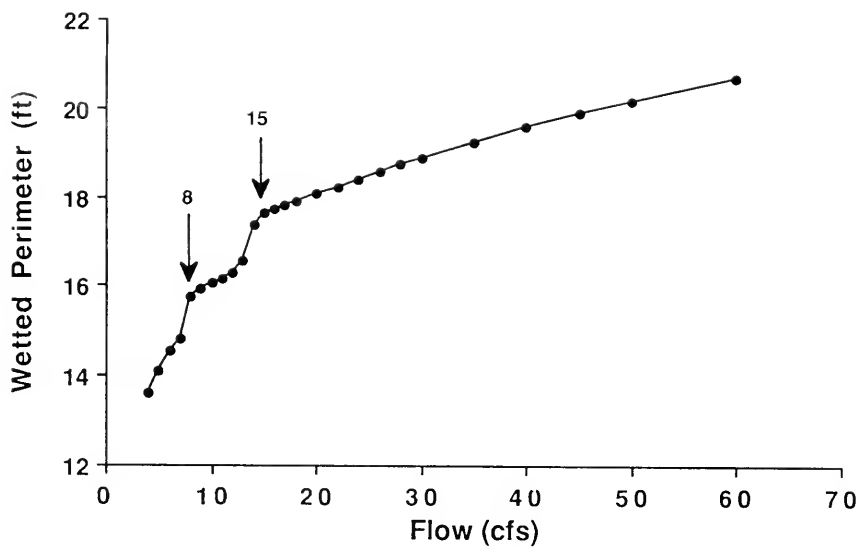


Figure 2-5. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Hell Roaring Creek.

STREAM NAME: Corral Creek

STREAM REACH: From the headwaters to the mouth - 4.6 miles

LOCATION: Sec. 34, T14S, R1E to Sec. 16, T14S, R1E

DESCRIPTION OF STREAM REACH:

Corral Creek originates in the Centennial Mountains of southwest Montana and flows in a northerly direction for 4.6 miles before entering Red Rock Creek, a tributary to Upper Red Rock Lake. In its upper reaches, Corral Creek cascades through steep, timbered slopes and limestone cliffs and changes to a meandering brook draining sagebrush/grassland slopes along its lower stretches. The riparian zone is vegetated with willow, sage, grasses, conifers and forbs. Average gradient of the 6 ft wide channel is approximately 77 ft per 1,000 ft. The 2.75 square mile drainage is controlled by the BLM (55%), private individuals (27%) and the State of Montana (18%). The BLM land is divided between the Centennial Mountains Primitive Area and the U.S. Sheep Experiment Station. The only major tributary to Corral Creek is Fruin Spring.

Lands within the Corral Creek drainage are used for recreation in the form of hunting, fishing and hiking, agricultural research, cattle grazing and, in the upper reaches, logging. Water from Corral Creek is used as the primary domestic water supply by one ranch in the valley. A salvage timber sale is being proposed by the BLM for the upper drainage.

Past logging activity in the upper drainage has resulted in the deposition of sediments in downstream reaches. The upper stream has a channel stability rating of only fair. Without proper management of the proposed BLM timber sale, further sedimentation may occur. Grazing within the riparian zone may also increase as a result of improved access to the stream created by new logging roads.

GAME FISH PRESENT: Brook trout, Yellowstone cutthroat trout, arctic grayling.

FISHERY:

As early as 1907, a resident population of arctic grayling was reported in Corral Creek (Henshall, 1907). In 1951, adult grayling were found in the lower stretches of Corral Creek during the spawning season (Nelson, 1954a). By September of the same year only young-of-the-year were present, indicating that the stream was providing spawning and rearing habitats for the adfluvial grayling population of the Red Rock Lakes. During 1979 and 1980, MDFWP personnel observed adult grayling during the spawning season in lower Corral Creek. A large beaver dam approximately 900 ft above the creek mouth may be a barrier to further upstream movement.

A 900 ft section of lower Corral Creek was electrofished on July 24 and August 20, 1980, after the grayling spawning season. Three hundred twenty-five brook trout, ranging from 2.0-12.9 inches, and 9 Yellowstone cutthroat trout from 3.9-6.2 inches were captured. Other species present were longnose sucker and mottled sculpin. No adult or fingerling grayling were captured.

The standing crop of brook trout in the section was estimated using a mark-recapture method (Table 2-2). Corral Creek supported approximately 547 brook trout, weighing a total of 43 pounds, per 1,000 ft of stream. The condition (length to weight ratio) of the trout was well above average. This is one of the highest populations of brook trout for streams sampled in the Beaverhead-Red Rock drainages.

Table 2-2. Estimated standing crop of brook trout in a 900 ft section of Corral Creek (T14S, R1E, Sec. 16D) on July 24, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	406	
	6.0 - 9.9	135	
	10.0 - 12.9	6	
		547(±69)	43(±3)

Corral Creek appears to no longer support a resident population of stream-dwelling (fluvial) grayling. There are indications that grayling from Upper Red Rock Lake still enter the creek each year to spawn. However, the reproductive contribution of Corral Creek is unknown.

WILDLIFE:

The Corral Creek drainage supports moose year-round and elk and mule deer from spring through fall. Other resident wildlife include beaver, mink and black bear.

WETTED PERIMETER:

Cross-sectional data were collected in a 83 ft riffle-pool sequence located near the mouth of Corral Creek (T14S, R1E, Sec. 16D). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 4.6 and 11.8 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-6. Lower and upper inflection points occur at about 1.5 and 6.0 cfs, respectively.

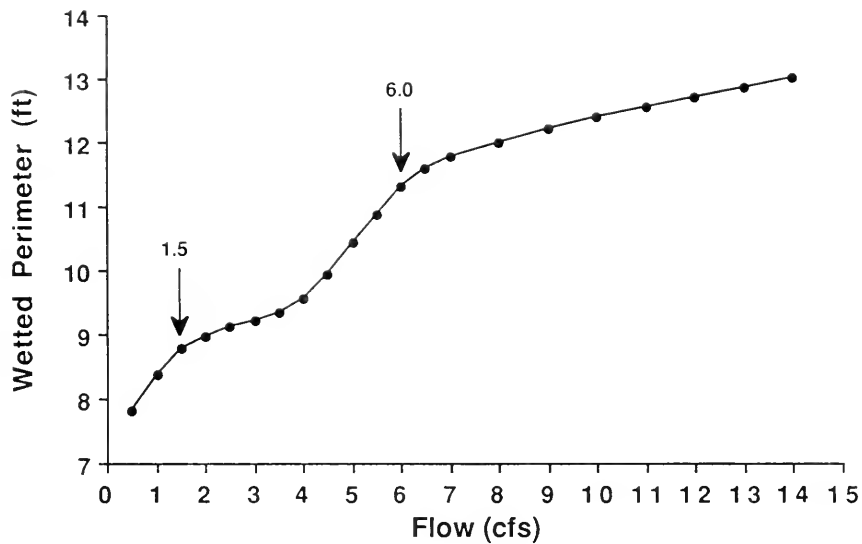


Figure 2-6. The relationship between wetted perimeter and flow for a single riffle cross-section in Corral Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect spawning and nursery habitats for the arctic grayling population of Upper Red Rock Lake; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 6.0 cfs (4,344 A.F./yr)

STREAM NAME: Red Rock Creek

STREAM REACH: From the headwaters to Upper Red Rock Lake - 13.7 miles

LOCATION: Sec. 18, T14S, R2E to Sec. 15 and 23, T14S, R1W

DESCRIPTION OF STREAM REACH:

Red Rock Creek arises in the Centennial and Henry Lake Mountains of southwest Montana. The stream meanders in an easterly direction for 13.7 miles through a sagebrush/grassland valley bordered by stands of lodgepole pine before entering Upper Red Rock Lake, the headwaters of the Red Rock River. Ownership of the 41.5 square mile drainage is shared by private individuals (29%), BLM (23%), USFS (22%), State of Montana (16%) and USFWS (Red Rock Lakes National Wildlife Refuge) (11%). Of the 9.5 square miles controlled by the BLM, 61% is within the Centennial Mountains Primitive Area and 32% in the U.S. Sheep Experiment Station. Tributaries to Red Rock Creek include Corral and Hell Roaring Creeks and numerous springs and unnamed tributaries. Average gradient of the 31 ft wide channel is 1.3 ft/1,000 ft. The riparian zone is vegetated with sage, grasses, conifers and a dense cover of willows. The bottom substrate consists of sand, silt and compacted gravel and rubble.

Lands within Red Rock Creek drainage are primarily used for recreation in the form of hunting, fishing and hiking, summer range for cattle, agricultural research and wildlife propagation. A creel census conducted from June through September, 1976 showed Red Rock Creek to be the most heavily fished stream on the Red Rock Lakes National Wildlife Refuge, with 832 fishing days recorded (Peterson, 1977).

The upper seven miles of Red Rock Creek drain Alaska Basin, an area that is heavily grazed by livestock. Damage to the stream's banks and the riparian zone are evident throughout the upper drainage. Increases in suspended sediment levels and summer water temperatures below Alaska Basin have been attributed to the effects of long-term overgrazing.

GAME FISH PRESENT: Brook trout, arctic grayling, mountain whitefish, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

Historically, arctic grayling populations were extensive in both the streams and lakes of the upper Centennial Valley. These populations have declined drastically and, today, the only major population occurs on the Red Rock Lakes National Wildlife Refuge in Upper Red Rock Lake. Red Rock Creek is the major spawning tributary for this population and each spring large numbers of lake grayling ascend this stream to reproduce.

Between 1976 and 1981, a 4,991 ft section of Red Rock Creek was electrofished during the grayling spawning migration (Table 2-3). From 35 to 192 spawners were captured each year. Total numbers captured are not comparable from year to year due to the differences in chronology of the spawning migrations.

Up until the early 1950's, grayling were reported to be common year-round residents of Red Rock Creek. During the Fall of 1975, 4.3 miles of Red Rock Creek were electrofished and no grayling were captured, suggesting that the once abundant fluvial (stream-dwelling) population no longer exists.

Table 2-3. Summary of arctic grayling captured in a 4,991 ft section of Red Rock Creek (T14S, R1E, Sec. 17) in May and June, 1976-1981.

Date	Number Captured	Mean Length (Range)
6-01-76	192	15.7 (11.8 - 18.2)
5-23-78	91	16.1 (13.2 - 17.7)
5-21-79	112	16.3 (14.6 - 17.9)
5-19-80	35	16.4 (15.2 - 18.0)
5-19-81	131	16.3 (13.1 - 17.7)

Red Rock Creek also provides important spawning and rearing habitats for the lake population of cutthroat and cutthroat x rainbow hybrid trout. Trout as large as 8 pounds have been captured by electrofishing in recent years during the spring spawning run.

Game fish inhabiting Red Rock Creek year-round are brook trout, mountain whitefish and cutthroat trout (Table 2-4). The brook trout is the predominant resident game species, comprising about 80% of the game fish numbers. The larger brook trout present in the Fall are likely spawners from the Red Rock Lakes.

Table 2-4. Summary of electrofishing survey data collected for a 4,991 ft section of Red Rock Creek (T14S, R1E, Sec. 17) in May and September, 1975.

Species	May, 1975		September, 1975	
	No.	Length Range (inches)	No.	Length Range (inches)
Arctic grayling	247	12.1 - 18.0	0	
Brook trout	218	5.0 - 15.8	123	2.4 - 17.8
Mountain whitefish	77	7.1 - 20.1	30	3.3 - 14.5
Cutthroat trout	12	5.5 - 22.6	4	14.4 - 15.2
Rainbow x cutthroat hybrid trout	1	7.6	0	

WILDLIFE:

The Red Rock Creek drainage supports moose year-round and antelope and mule deer from spring through fall. Otter, beaver and mink are the main furbearers within the drainage and blue grouse the main upland game bird. Lower Red Rock Creek provides excellent habitat for waterfowl during the spring and fall migrations and the summer breeding season.

WETTED PERIMETER:

Cross-sectional data were collected in a 126 ft section of Red Rock Creek in T14S, R1E, Sec. 17A. Five cross-sections defining the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 25.8, 52.5 and 89.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-7. Lower and upper inflection points occur at about 7 and 15 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect crucial spawning and rearing habitats for the arctic grayling and cutthroat trout populations of Upper Red Rock Lake; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 15 cfs (10,859 A.F./yr)

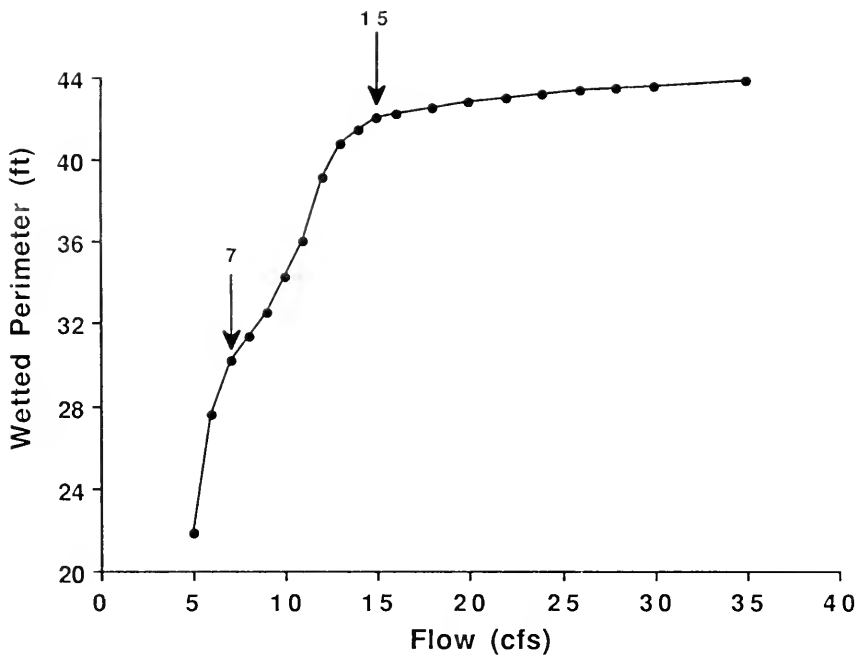


Figure 2-7. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Red Rock Creek.

STREAM NAME: Narrows Creek

STREAM REACH: From the spring in Sec. 18A, T13S, R1E to Elk Lake - 2.5 miles

LOCATION: Sec. 18, T13S, R1E to Sec. 29, T13S, R1E

DESCRIPTION OF STREAM REACH:

Narrows Creek originates along the Landon Ridge of the Gravelly Range in the northeast corner of the Centennial Valley and flows through a narrow floodplain for approximately 3.5 miles before entering Elk Lake in the Red Rock River drainage. The three square mile drainage is characterized by heavily timbered slopes. Ownership of the drainage is shared by the USFS (65%), the State of Montana (32%) and the BLM (2%). The riparian zone along the upper reaches is comprised of conifers and willows. At its mouth, the stream banks are vegetated with grasses, forbs and clumps of willow. The average gradient of the two foot wide channel is approximately 106 ft per 1,000 ft. Several unnamed streams and springs are the only tributaries to Narrows Creek. A small pond 0.7 miles above the mouth was constructed in the streambed in the 1920s.

Lands within the Narrows Creek drainage are used primarily for cattle grazing and recreation in the form of hunting and fishing. A small resort with a lodge and cabins is located on Elk Lake within the drainage. Due to the stream's small size and lack of resident fish, fishing in the area is limited to the pond on the creek and Elk Lake.

Elk Lake, at an elevation of 6,800 ft, is 283 acres in size and has a maximum depth of 70 ft. Arctic grayling, burbot and cutthroat, lake, rainbow and rainbow x cutthroat hybrid trout are the resident game fish. Arctic grayling were first stocked in Elk Lake in 1950, with the last plant in 1957. Cutthroat trout, which are planted annually, provide a popular and highly utilized sport fishery.

Springs about 0.5 miles above the pond on Narrows Creek provide most of the flow, with the creek becoming intermittent above the springs. Flows near the mouth of Narrows Creek range from a high of about 3.0 cfs during May to 0.2 cfs during August (Lund, 1974).

GAME FISH PRESENT: Arctic grayling, cutthroat trout, rainbow x cutthroat hybrid trout, rainbow trout.

FISHERY:

Although Narrows Creek does not support a resident fishery, it provides essential spawning and nursery habitats for the arctic grayling and trout populations of Elk Lake.

Lund (1974) extensively studied the spawning runs in Narrows Creek in 1971 and 1972. Spawners began entering the creek in early May with the disappearance of ice from the lake. These runs typically lasted to the end of June. In 1971, a total of 520 adult grayling and cutthroat, rainbow, and cutthroat x rainbow hybrid trout entered Narrows Creek to spawn. In 1972, 459 adults were counted. A total of 8,120 and 4,566 fry were caught leaving

the stream from June 22 to September 15, 1972 and from June 25 to September 12, 1973, respectively. Peterson (1972) reported that 23,374 fry were produced in 1971. Some trout fry remained in Narrows Creek after the out migration period each year. If these fry over-wintered in the creek, they would leave as fingerlings the following year. Lund (1974) postulated that most of the out migrating trout fingerlings captured during his study came from the upstream pond because the creek freezes solid in winter and, therefore, could provide little winter habitat for fish.

WILDLIFE:

Beaver, mink and mule deer are the primary wildlife inhabiting the Narrows Creek drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain critical spawning and nursery habitats for the grayling and trout populations of Elk Lake; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: May 1 - July 15 -- 1.2 cfs (869 A.F./yr)
July 16 - April 30 -- 0.5 cfs (362 A.F./yr)

Lund (1974) concluded that the recruitment of grayling and cutthroat trout in Elk Lake appeared to be controlled by the production of fry in Narrows Creek, which, in turn, partly depended on the stream flow during the spawning season. A flow of 1.2 cfs was needed to allow adult fish access to the uppermost spawning areas. The same flow was recommended throughout the incubation period to sustain the inter-gravel water flow needed for successful egg development. The MDFWP requests that the following flows be reserved for the fishery:

<u>Time Period</u>	<u>Amount (cfs)</u>	<u>Purpose</u>
May 1-July 15	1.2	Maintenance of spawning habitat and for egg incubation
July 16-April 30	0.5	Protect nursery habitat of young fish, including any winter habitat that may exist

STREAM NAME: Tom Creek

STREAM REACH: From the headwaters to Upper Red Rock Lake - 6.4 miles

LOCATION: Sec. 3, T15S, R1E to Sec. 23, T14S, R1W

DESCRIPTION OF STREAM REACH:

Tom Creek originates in the Centennial Mountains of southwest Montana and flows in a northwesterly direction for approximately 6.4 miles before entering Upper Red Rock Lake in the Red Rock River drainage. The stream flows through a floodplain vegetated with willows, sagebrush, conifers, aspens, grasses and forbs. The upper drainage is steep and forested while the lower portion consists of grassland/sagebrush communities and marshlands. The 11.0 square mile drainage is controlled by the BLM (55%), USFWS (18%), private individuals (18%) and the State of Montana (9%). The 9 ft wide channel has a fairly steep gradient, averaging 28 ft per 1,000 ft. There are no named tributaries to Tom Creek.

Lands within the Tom Creek drainage are managed for wildlife habitat, recreation, agricultural research and cattle grazing. Forty-two percent of the land managed by the BLM is located within the U.S. Sheep Experiment Station. The remainder is within the Centennial Mountains Primitive Area.

The private lands above the county road crossing Tom Creek are the major source of sediment to the drainage. Further investigation revealed 80% active bank erosion in the lower private section compared to 26% above the private land (BLM, unpublished data). Due to the numerous beaver dams on the lower stream, much of the suspended sediment is being deposited in important riffle and spawning areas.

GAME FISH PRESENT: Brook trout, arctic grayling.

FISHERY:

The MDFWP electrofished a 2,876 ft section of Tom Creek during the fall of 1975 (Peterson, 1976). The brook trout was the only game species present. In June of 1976, three sections of Tom Creek were electrofished by the MDFWP (Peterson, 1979). Four grayling spawners from the Red Rock Lakes and several brook trout were captured. Table 2-5 summarizes the electrofishing survey data collected for Tom Creek in 1975 and 1976.

Table 2-5. Summary of electrofishing survey data collected for Tom Creek in a 2,876 ft section (T14S, R1W, Sec. 25) in September, 1975 and three sections of an undetermined length (T14S, R1W, Sec. 23 and 25) in June, 1976.

Fish Species	Number Captured		Length Range (inches)	
	Sept., 1975	June, 1976	Sept., 1975	June, 1976
Brook trout	53	Several	2.6 - 10.6	-
Arctic grayling	None	4	-	14.9 - 18.0

The silting of spawning areas, blockage of the channel by beaver dams, the relocation of the lower mile of the original channel due to beaver activity, and streambank deterioration resulting from overgrazing have been cited as factors limiting the present use of Tom Creek by spawning grayling.

WILDLIFE:

The Tom Creek drainage supports moose year-round and mule deer and elk from spring through fall. Black bear and an occasional grizzly bear are also present. Mink and blue grouse are other wildlife inhabiting the drainage.

WETTED PERIMETER:

Cross-sectional data for Tom Creek were collected in a 57 ft section in T14S, R1W, Sec. 25A. Two riffle cross-sections were established; however, one was discarded due to calibration problems. The WETP program was calibrated to field data collected at flows of 0.7, 3.4 and 16.6 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-8. A prominent upper inflection point occurs at a flow of about 1.4 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect spawning and nursery habitats for the adfluvial arctic grayling population of the Red Rock Lakes; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.4 cfs (1,014 A.F./yr)

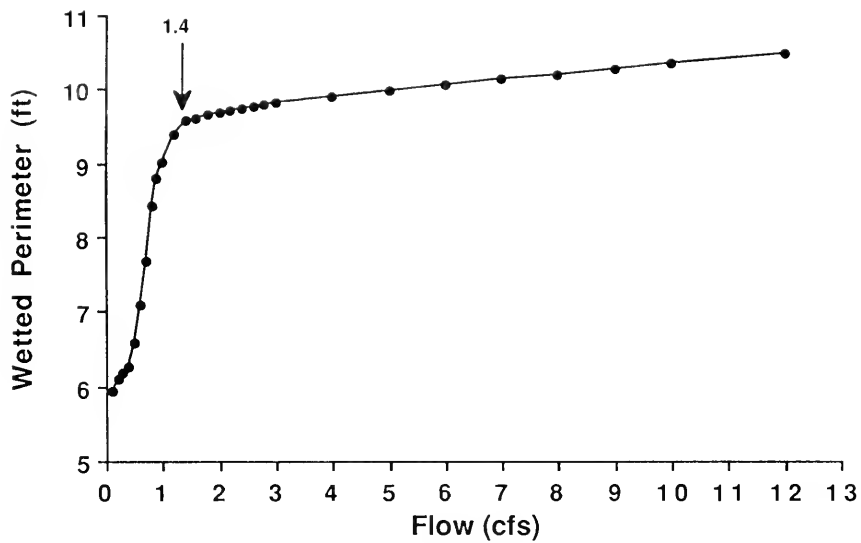


Figure 2-8. The relationship between wetted perimeter and flow for a single riffle cross-section in Tom Creek.

STREAM NAME: Odell Creek

STREAM REACH: From the headwaters to Lower Red Rock Lake - 14.5 miles

LOCATION: Sec. 9, T15S, R2W to Sec. 2, T14S, R2W

DESCRIPTION OF STREAM REACH:

Odell Creek originates on the northern slope of the Centennial Mountains of southwest Montana. It flows in a northerly direction for approximately 14.5 miles before entering Lower Red Rock Lake in the Red Rock River drainage. The 27.7 square mile drainage is characterized by steep, timbered slopes in the upper half of the basin and grassland/sagebrush and marsh communities in the lower portion. Control of the drainage is shared by the BLM (78%), USFWS (9%), private individuals (9%) and the State of Montana (4%). Spring and Shambow Creeks are the only named tributaries to Odell Creek. The average gradient of the 23 ft wide channel is approximately 16 ft per 1,000 ft. In the upper drainage, the stream cascades through a flood-plain vegetated with aspen, conifers, grasses and forbs. The riparian zone along the lower meandering portion of the stream is vegetated with willow, grasses and forbs. The fluvial nature of Odell Creek is frequently interrupted in its lower reaches by beaver dams.

Lands within the Odell creek drainage are used for agricultural research, wildlife propagation, irrigated hay production, cattle grazing and recreation in the form of hiking, camping, cross country skiing, snowmobiling and fishing. The lower portion of the creek is within the boundaries of the Red Rock Wildlife Refuge, which was created in 1935 for the protection of the then endangered trumpeter swan. Seventy-six percent of the BLM land is managed by the U.S. Sheep Experiment Station. The remainder is within the boundaries of the Centennial Mountains Primitive Area.

Grazing, on and off the Refuge, has resulted in trampled banks, the loss of undercut banks and streamside vegetative cover, the widening of the stream channel and an increased rate of erosion along some reaches of the stream. The deposition of sediment is severe in stretches of the lower creek due to the low stream velocities resulting from numerous beaver ponds. Because the majority of the soils within the Odell Creek drainage are classified as unstable and the channel stability is rated only fair, increased sediment loads will be a continual threat to the aquatic resource (Randall, 1978).

GAME FISH PRESENT: Brook trout, arctic grayling, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

In the fall of 1975, the MDFWP electrofished a 3,971 ft section of Odell Creek at approximate stream mile 2.0 to determine the status of resident grayling (Peterson, 1976). Game fish captured in descending order of abundance were brook trout, arctic grayling and cutthroat trout (Table 2-6). Odell Creek was the only stream sampled on the refuge in which adult grayling were present in the fall of the year, suggesting that the creek still supported a low density resident (fluvial) population.

Table 2-6. Summary of electrofishing survey data collected for a 3,971 ft section of Odell Creek (T14S, R2W, Sec. 14D) on October 1, 1975.

Fish Species	Number Captured	Length Range (inches)
Brook trout	40	2.5 - 16.9
Arctic grayling	2	2.5 - 9.2
Cutthroat trout	2	2.5 - 16.9

The MDFWP electrofished a section of Odell Creek beginning at about stream mile 5.0 in June, 1976 to assess spawning use by adfluvial grayling from the Red Rock Lakes (Peterson, 1979). Sixty-seven mature arctic grayling, all in spawning condition, were captured (Table 2-7). Grayling were not captured in the upper portion of the section which is severely dewatered during the irrigation season.

Table 2-7. Summary of electrofishing survey data collected for a 10,560 ft section of Odell Creek (T14S, R2W, Sec. 24C-Sec. 14D) on June 2, 1976.

Fish Species	Number Captured	Length Range (inches)
Arctic grayling	67	13.6 - 17.0
Brook trout	39	3.7 - 14.0
Rainbow x cutthroat hybrids	2	4.7 - 18.5

An evaluation of the seasonal electrofishing survey data for Odell Creek indicates that the resident trout population is dominated by brook trout. The creek provides spawning and rearing habitats for the adfluvial grayling population of the Red Rock Lakes and also appears to support low numbers of fluvial grayling.

WILDLIFE:

The Odell Creek drainage supports moose year-round and mule deer and elk from spring through late fall. Beaver, mink, marten, black bear and an occasional mountain goat and grizzly bear are also found within the drainage. Swans and other waterfowl use the lower creek during migration and the summer breeding season. One of a very few active peregrine falcon nest sites in Montana is located within the Odell Creek drainage.

WETTED PERIMETER:

Cross-sectional data for Odell Creek were collected in a 203 ft riffle-pool sequence in T14S, R2W, Sec. 25A. Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 12.8, 49.1 and 72.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-9. Lower and upper inflection points occur at about 5 and 11 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid population, which may include fluvial arctic grayling; to protect critical habitat for fluvial arctic grayling; to protect important spawning and rearing habitats for the arctic grayling population of the Red Rock Lakes; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 11 cfs (7,964 A.F./yr)

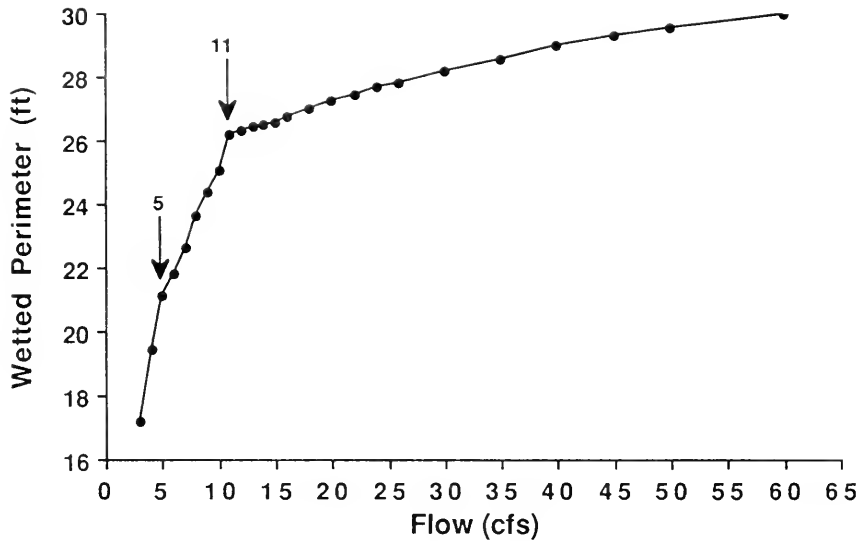


Figure 2-9. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Odell Creek.

STREAM NAME: Jones Creek

STREAM REACH: From the headwaters to the Lakeview Road crossing - 3.7 miles

LOCATION: Sec. 8, T15S, R3W to Sec. 28, T14S, R3W

DESCRIPTION OF STREAM REACH:

Jones Creek originates on the north slope of the Centennial Mountains at the Continental Divide at an elevation of 8,400 ft. The stream flows in a north-northwesterly direction for about 7.4 miles to its juncture with Winslow Creek to form Mud Creek, a tributary to the Red Rock River. The 8.3 square mile drainage is heavily timbered in the higher elevations and is characterized by willow bog communities in the lower elevations. Ownership of the drainage is controlled by the BLM (68.7%) and private individuals (31.3%). Most of the BLM segment of the drainage is contained in the Centennial Mountains Primitive Area. The stream is bordered by a riparian zone of willow, birch, alder, aspen, grasses and sedges. A large area of abandoned beaver ponds is located below the study section. The average gradient of the 10.4 ft wide channel is 45 ft/1,000 ft.

Lands within the Jones Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access into the area is restricted by private land owners in the lower drainage.

The BLM controlled portion of the drainage is included in a single grazing allotment which is managed on a deferred-rotation basis. A BLM range evaluation found this allotment to be in good erosional condition and fair vegetative shape, but undergoing a declining trend (BLM, 1980).

A riparian zone inventory (Myers, 1976) resulted in an unsatisfactory rating for the stream. Numerous areas of active bank erosion were observed along the Jones Creek channel, and sedimentation of the cobble substrate was observed to be extreme during the 1982 field season.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Jones Creek was electrofished on July 29 and August 12, 1982. Fifty-five westslope cutthroat trout, ranging from 2.0-9.0 inches, were captured. The mottled sculpin was the only other species present.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-8). This 1,000 ft section supported 31 trout 4.5 inches and longer, weighing four pounds. Fish six inches and longer comprised 39% of the population. Fish condition (length to weight ratio) was excellent. Trout numbers within the study section may have been limited by the extreme sedimentation that was observed throughout the reach.

Table 2-8. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Jones Creek (T14S, R3W, Sec. 33AD) on July 29, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	4.5 - 9.0	31(±8)	4(±1)

Meristic examination of representative fish collected from Jones Creek found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

WILDLIFE:

The Jones Creek drainage supports moose year-round and mule deer and elk from spring through fall. Antelope are found within the lower portion of the drainage from spring through fall. Other wildlife present include beaver, mink and black bear. Blue grouse and a few ruffed grouse are also present.

WETTED PERIMETER:

Cross-sectional data were collected in a 136 ft riffle sequence of Jones Creek at about stream mile 4.5 (T14S, R3W, Sec. 33AD). Approximately 48% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 1.7, 3.2 and 7.0 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-10. Lower and upper inflection points occur at about 1.1 and 1.9 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to protect important habitat for native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.9 cfs (1,376 A.F./yr)

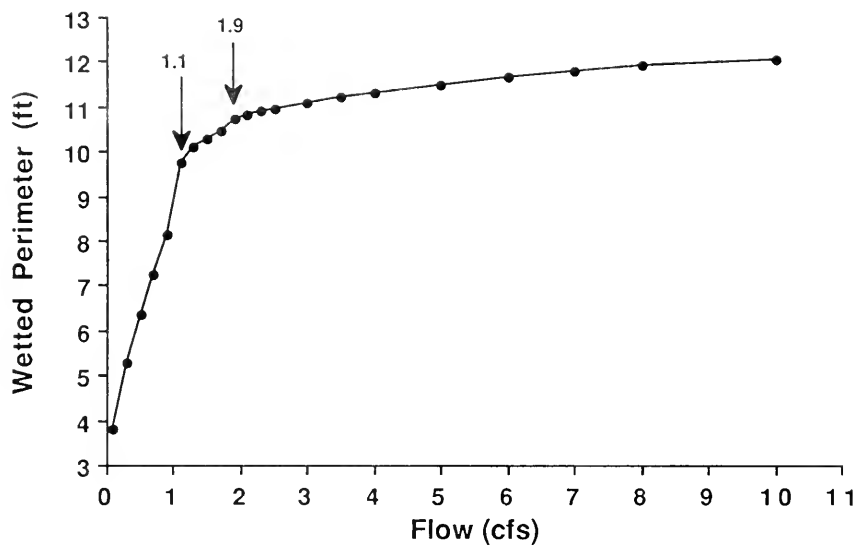


Figure 2-10. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Jones Creek.

STREAM NAME: Peet Creek

STREAM REACH: From the headwaters to the storage reservoir in Sec. 34A, T14S, R4W - 2.9 miles

LOCATION: Sec. 10, T15S, R4W to Sec. 34, T14S, R4W

DESCRIPTION OF STREAM REACH:

Peet Creek originates on the north slope of the Centennial Mountains at the Continental Divide at an elevation of approximately 8,600 ft. The stream flows in a north-northwesterly direction for 9.1 miles before entering the Red Rock River. The 21.5 square mile drainage is characterized by heavily timbered slopes in the higher elevations, sagebrush-grassland communities in the mid-elevations and willow bog communities near the stream mouth. Ownership of the drainage is controlled by private individuals (57%), the BLM (34%) and the State of Montana (9%). Several small unnamed lakes are located in the upper drainage. A small irrigation storage reservoir located on private land below the study area inundates a portion of the stream. The stream is bordered by a relatively broad riparian zone of willow, birch, alder, aspen, grasses and sedges, and is marked by numerous areas of beaver activity. The only named tributary to Peet Creek is the East Fork of Peet Creek. The average gradient of the 8.1 ft wide channel is 41.6 ft/1,000 ft.

Lands within the Peet Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a gravel road from the Price Creek drainage and a privately controlled dirt road which parallels the stream.

The BLM controlled portion of the drainage is included in a single grazing allotment which is managed on a rest-rotation basis. A BLM range evaluation found this allotment to be in good erosional condition and excellent vegetative shape, but undergoing a declining trend. A stream channel stability evaluation conducted below the storage reservoir resulted in a fair rating for Peet Creek, while riparian zone evaluations conducted in the present study area resulted in poor to fair ratings for the stream (BLM, 1980).

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Peet Creek was electrofished on July 29 and August 12, 1982. Two hundred four westslope cutthroat trout, ranging from 2.2-8.5 inches, were captured. The mottled sculpin was the only other species present.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-9). The section supported 312 trout 3.0 inches and longer, weighing 11 pounds. Only 1% of the fish were six inches or longer, while 78% were between 3.0 and 3.9 inches in length. The prevalence of small fish in the population suggests that Peet Creek provides important spawning and rearing habitats for the larger cutthroat trout that seasonally inhabit the downstream storage reservoir.

Table 2-9. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Peet Creek (T15S, R4W, Sec. 3AB) on July 29, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	3.0 - 3.9	243	
	4.0 - 5.4	56	
	5.5 - 8.5	13	
		312(±72)	11(±2)

Meristic examination of representative fish collected from Peet Creek found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

WILDLIFE:

From spring through fall, the Peet Creek drainage seasonally supports moose, antelope, mule deer and elk. An occasional black bear is also present. Mink and blue grouse are other wildlife inhabiting the drainage.

WETTED PERIMETER:

Cross-sectional data for Peet Creek were collected in a 179 ft riffle sequence at about stream mile 6.5 (T15S, R4W, Sec. 3AB). Approximately 17% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 1.3, 4.3 and 16.6 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-11. Lower and upper inflection points occur at about 0.3 and 0.9 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.9 cfs (652 A.F./yr)

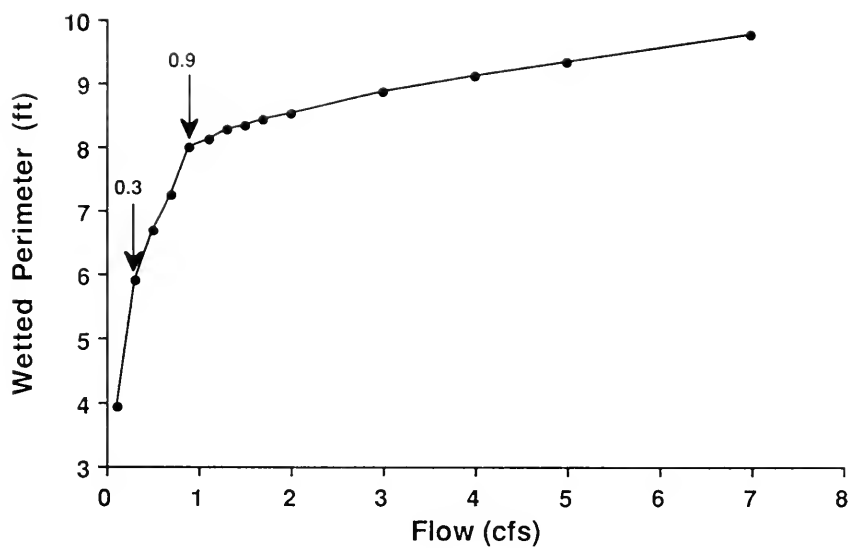


Figure 2-11. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Peet Creek.

STREAM NAME: Long Creek

STREAM REACH: From the confluence of Jones Creek to the mouth - 18.6 miles

LOCATION: Sec. 31, T12S, R3W to Sec. 8, T14S, R4W

DESCRIPTION OF STREAM REACH:

Long Creek originates in the Snowcrest Mountains of southwest Montana and flows in a southerly direction for approximately 23 miles before joining the Red Rock River, approximately three miles upstream from Lima Reservoir. Long Creek primarily drains sagebrush/grassland hillsides and benches. Control of the 45.5 square mile drainage is shared by the BLM (14%), USFS (57%), private individuals (23%) and the State of Montana (5%). Major tributaries to Long Creek include Pole, Jones, Crow, Piute and Mohican Creeks. The average gradient of the 14 ft wide channel is approximately 6 ft/1,000 ft. The riparian zone is vegetated with willow, birch, grasses and forbs. Numerous beaver dams within the channel interrupt the fluvial nature of the stream.

Lands within the Long Creek drainage are used primarily for cattle and sheep grazing, irrigated crop production and recreation in the form of hunting and fishing. The Centennial Divide Road parallels Long Creek for the majority of its length, providing access throughout the drainage.

The grazing of the riparian zone by sheep and cattle has caused extensive damage to the trout habitat of Long Creek. This has been manifested in the loss of undercut banks and streambank vegetation, the widening of the stream channel and increased sediment yields. The BLM rates the channel stability of Long Creek only fair with 21% active bank erosion. The lack of silt-free spawning gravels appears to be a limiting factor to the fishery. Haugen (1975) identified overuse by stock as the primary limiting factor to the fishery of upper Long Creek. He felt that excessive siltation, bank instability and loss of streambank cover resulted from this overuse.

The lower three miles of Long Creek are severely dewatered during the summer irrigation season. Little of the stream's natural flow remains in the channel at its confluence with the Red Rock River.

GAME FISH PRESENT: Cutthroat trout, brook trout.

FISHERY:

A 1,000 ft section of Long Creek was electrofished on July 23 and August 13, 1980. Forty-six cutthroat trout, ranging from 4.0-13.9 inches, and 5 brook trout from 6.0-14.2 inches were captured. Other species present were longnose sucker, longnose dace and mottled sculpin. It should be noted that approximately one-third of the section was inundated as a result of beaver activity. Most of the larger cutthroat trout were captured in this portion of the section.

The standing crop of cutthroat trout was estimated using a mark-recapture method (Table 2-10). This 1,000 ft section supported about 138 cutthroat trout 4.0 inches and longer, weighing a total of 26 pounds. The

condition of the trout (length to weight ratio) was considered above average for streams electrofished in the Red Rock-Beaverhead drainages. The population of brook trout was too sparse to estimate using the mark-recapture method.

Table 2-10. Estimated standing crop of cutthroat trout in a 1,000 ft section of Long Creek (T13S, R4W, Sec. 11B) on July 23, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Cutthroat trout	4.0 - 5.9	33	
	6.0 - 9.9	96	
	10.0 - 13.9	9	
		138(±64)	26(±13)

The BLM collected cutthroat from Long Creek for meristic analyses to determine the degree of hybridization between the native westslope cutthroat trout and introduced Yellowstone cutthroat trout. The trout of Long Creek were found to have strong Yellowstone cutthroat traits, but possessed a spotting pattern more typical of westslope cutthroat.

Nelson (1954a) surveyed the tributaries to the Red Rock River in 1951-52 to determine the status of arctic grayling. Seven young-of-the-year grayling were found in Long Creek during the fall of 1952, indicating that Long Creek has in past years provided spawning and rearing habitats for this species.

WILDLIFE:

Lands adjacent to Long Creek seasonally support antelope, mule deer and elk from spring through fall, while moose are present year-round. Other wildlife present include beaver and mink. The resident game birds are sage and blue grouse.

WETTED PERIMETER:

Cross-sectional data were collected in a 122 ft riffle-run sequence of Long Creek in T13S, R4W, Sec. 2D. Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 5.7, 10.2 and 24.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-12. Lower and upper inflection points occur at about 2.2 and 3.4 cfs, respectively.

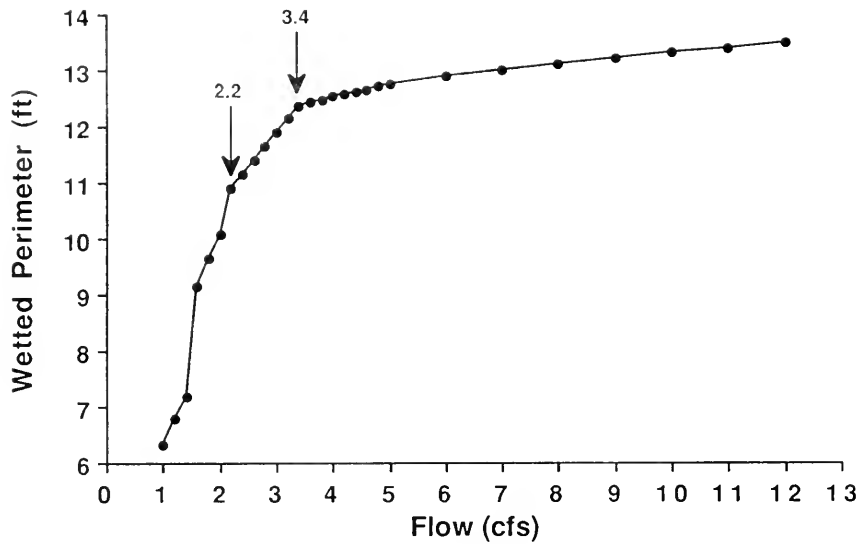


Figure 2-12. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Long Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.4 cfs (2,461 A.F./yr)

STREAM NAME: East Fork Clover Creek

STREAM REACH: From the headwaters to the mouth - 5.8 miles

LOCATION: Sec. 26, T12S, R5W to Sec. 7, T13S, R5W

DESCRIPTION OF STREAM REACH:

East Fork Clover Creek originates in the Snowcrest Mountains of southwest Montana and flows in a southeasterly direction for 5.8 miles before entering Clover Creek. Clover Creek continues for 6.4 miles before joining Wolverine Creek, a tributary to the Red Rock River. Land ownership within the 7.5 square mile drainage is shared by the USFS (50%), State of Montana (35%), private individuals (21%), and BLM (4%). The 9 ft wide channel has an average gradient of 72 ft per 1,000 ft. The stream cascades through a riparian zone vegetated with willow, grasses and forbs. There are no major tributaries to East Fork Clover Creek. The drainage consists of grassland/sagebrush hillsides in the lower basin and forested slopes in the upper basin.

Lands with the East Fork Clover Creek drainage are used for livestock grazing, which occurs on private and public lands, and recreation in the form of hunting, fishing and hiking. An unimproved road parallels the lower 1.5 miles of stream. Access to the upper reaches is provided by a trail system.

Potential and existing environmental problems within the East Fork Clover Creek drainage are related to cattle grazing and other agricultural activities. The physical removal of willows and the overgrazing and trampling of the riparian zone by livestock along portions of the stream have contributed to the widening of the stream channel, destruction of undercut banks and loss of bank cover.

GAME FISH PRESENT: Brook trout, cutthroat trout.

FISHERY:

A 1,000 ft section of East Fork Clover Creek was electrofished on July 21 and August 12, 1980. Ninety brook trout, ranging from 2.0-9.9 inches, and 13 cutthroat trout from 4.2-9.6 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-11). This 1,000 ft section supported about 270 brook trout 4.0 inches and longer, weighing 35 pounds. When compared to other streams of this size in the Beaverhead National Forest, population numbers and trout condition were above average.

Table 2-11. Estimated standing crop of brook trout in a 1,000 ft section of East Fork Clover Creek (T13S, R5W, Sec. 8B) on July 21, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	111	
	6.0 - 9.9	<u>159</u>	
		270(±101)	35(±13)

The BLM collected cutthroat trout from East Fork Clover Creek for meristic analyses to determine the degree of hybridization within the population. It appears that the cutthroat trout of the East Fork are Yellowstone and westslope hybrids.

WILDLIFE:

The East Fork Clover Creek drainage supports moose year-round and mule deer and elk from spring through early winter. Other resident wildlife are beaver, mink and black bear. The blue grouse is the main upland game bird within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 78 ft riffle-pool sequence of the East Fork in T13S, R5W, Sec. 8B. Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 4.2, 6.9 and 10.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-13. Lower and upper inflection points occur at about 1.4 and 4.4 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4.4 cfs (3,185 A.F./yr)

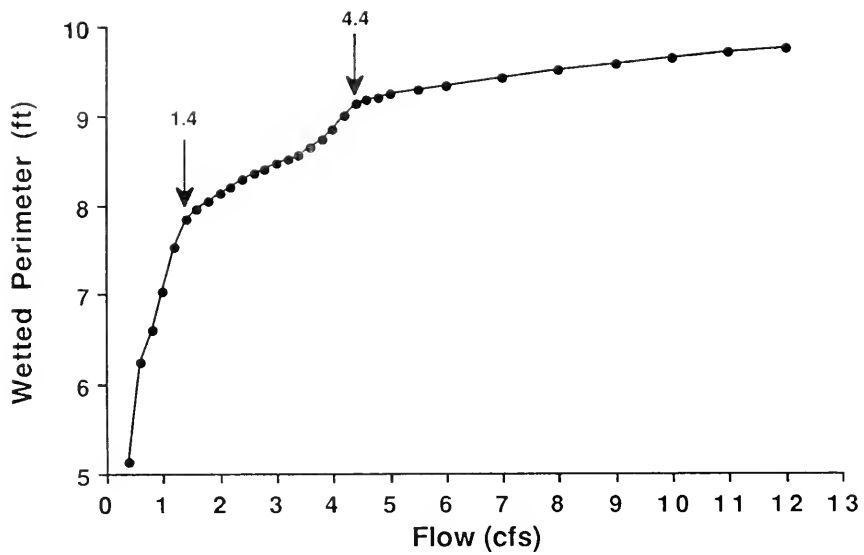


Figure 2-13. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in East Fork Clover Creek.

STREAM NAME: Indian Creek

STREAM REACH: From the headwaters to the mouth - 5.0 miles

LOCATION: Sec. 15, T14S, R12W to Sec. 8, T14S, R11W

DESCRIPTION OF STREAM REACH:

Indian Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of 8,320 ft. The stream flows in an east-northeasterly direction for approximately 5.0 miles before joining Cabin Creek, a tributary to Big Sheep Creek. The only named tributary to Indian Creek is Sawlog Creek. The 7.7 square mile drainage is characterized by high elevation sagebrush-grassland communities. Ownership of the drainage is shared by the USFS (48%), the BLM (32%) and private individuals (20%). The stream is bordered by a narrow riparian zone of scattered willow clumps, grasses and sedges. The average gradient of the 2.9 ft wide channel is 33.3 ft/1,000 ft.

Lands within the Indian Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a dirt road which parallels the stream and leads to Morrison Lake. The lake supports the majority of the recreational fishing in the immediate vicinity.

The BLM portion of the drainage is contained in a single grazing allotment which is managed on a rest-rotation basis. A BLM range evaluation found this allotment to be in fair condition in terms of soil erosion and in good vegetative condition, but undergoing a declining trend. A riparian zone inventory resulted in a fair condition rating for the stream (BLM, 1980).

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Indian Creek was electrofished on July 8 and August 3, 1982. Eighteen westslope cutthroat trout, ranging from 3.8-7.7 inches, were captured. No other species were present.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-12). The section supported an estimated 19 trout 4.0 inches and longer, weighing one pound. The low numbers of fish in the study section possibly result from the limited amount of overhanging brush canopy and pool cover, combined with the small size of the stream. Fish captured during the electrofishing survey appeared to be limited to these cover types. A second 1,000 ft section (T14S, R12W, Sec. 24AC) located downstream from the above study section was electrofished on July 8, 1982. This section, which was virtually lacking in overhanging canopy and had very few pools, yielded a total of four cutthroat trout (5.1-6.2 inches).

Table 2-12. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Indian Creek (T14S, R12W, Sec. 24BD) on July 8, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	4.0 - 7.7	19(±7)	1(±0)

BLM biologists collected cutthroat trout from a 1,100 ft section of Indian Creek in July, 1980. Meristic examination of these fish found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

Instream rock structures were positioned in Indian Creek by BLM volunteers during the summer of 1982. Increased pool habitat resulting from these structures may increase the cutthroat trout population of the stream.

WILDLIFE:

The Indian Creek drainage supports antelope year-round and seasonal populations of elk and mule deer from spring through fall. Other wildlife inhabiting the drainage include mountain goat and bobcat.

WETTED PERIMETER:

Cross-sectional data were collected in a 309 ft riffle sequence of Indian Creek at stream mile 2.7 (T14S, R12W, Sec. 24AC). Approximately 44% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 0.7, 1.7 and 2.6 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-14. A prominent upper inflection point occurs at a flow of about 0.2 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.2 cfs (145 A.F./yr)

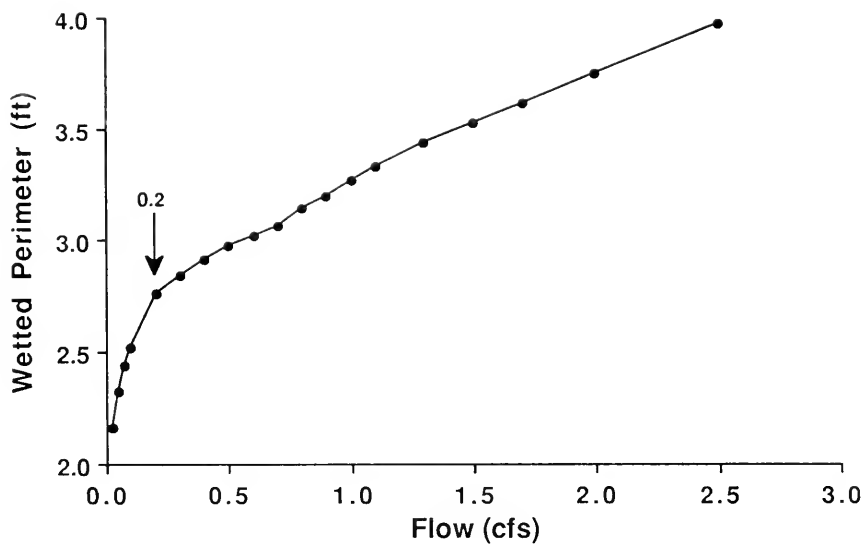


Figure 2-14. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Indian Creek.

STREAM NAME: Cabin Creek

STREAM REACH: From the headwaters to the mouth - 12 miles

LOCATION: Sec. 8, T14S, R11W to Sec. 4, T15S, R10W

DESCRIPTION OF STREAM REACH:

Cabin Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of 8,400 ft. The stream flows in a southeasterly direction for about 12 miles before joining Nicholia Creek to form Big Sheep Creek, a tributary to the Red Rock River. The 80 square mile drainage is heavily timbered in the extreme upper reaches, but is mainly characterized by high elevation sagebrush-grassland communities. Ownership of the drainage is shared by the BLM (35%), USFS (34%), private individuals (25%) and the State of Montana (5%). Named tributaries to Cabin Creek include Indian, Cow, Porcupine Canyon, Simpson and Tex Creeks. The stream is bordered by a riparian zone of varying width, consisting of willow, grasses and sedges, and characterized by a high degree of beaver activity. The average gradient of the 5.3 ft wide channel is 22.1 ft/1,000 ft.

Lands within the Cabin Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a gravel road and several dirt roads and Jeep trails.

Numerous BLM grazing allotments are included in the Cabin Creek drainage. The headwater region where the present study was undertaken includes portions of two allotments which are managed on a rest-rotation basis. A BLM evaluation of these allotments found them to be in good to excellent condition.

A riparian zone evaluation was conducted on an upper reach of Cabin Creek near the present study area. The riparian condition was rated as good (BLM, 1980).

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Cabin Creek was electrofished on July 8 and August 3, 1982. Seventy-eight westslope cutthroat trout from 2.5-6.8 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-13). The section supported 133 smaller (3.0-4.9 in) trout, having a biomass of 4 pounds. No estimate of larger trout could be derived due to the low numbers captured.

Table 2-13. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Cabin Creek (T14S, R12W, Sec. 1DD, Sec. 12AA) on July 8, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	3.0 - 4.9	133(±56)	4(±2)

BLM biologists collected cutthroat trout from Cabin Creek in 1980. Meristic examination of these fish found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

The population survey revealed a stream habitat capable of supporting native westslope cutthroat trout. Furthermore, the preponderance of young fish suggested that the upper reaches of Cabin Creek may provide important spawning and rearing habitats for the cutthroat population of the drainage.

WILDLIFE:

The Cabin Creek drainage supports antelope and sage grouse from spring through fall, elk in fall and winter and mule deer year-round. Important winter range for mule deer is found within the drainage. Other resident wildlife include black bear.

WETTED PERIMETER:

Cross-sectional data were collected in an 84 ft riffle sequence located at about stream mile 11.9 (T14S, R12W, Sec. 1DD). Approximately 3% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 0.6, 1.1 and 4.9 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-15. A prominent upper inflection point occurs at 0.4 cfs.

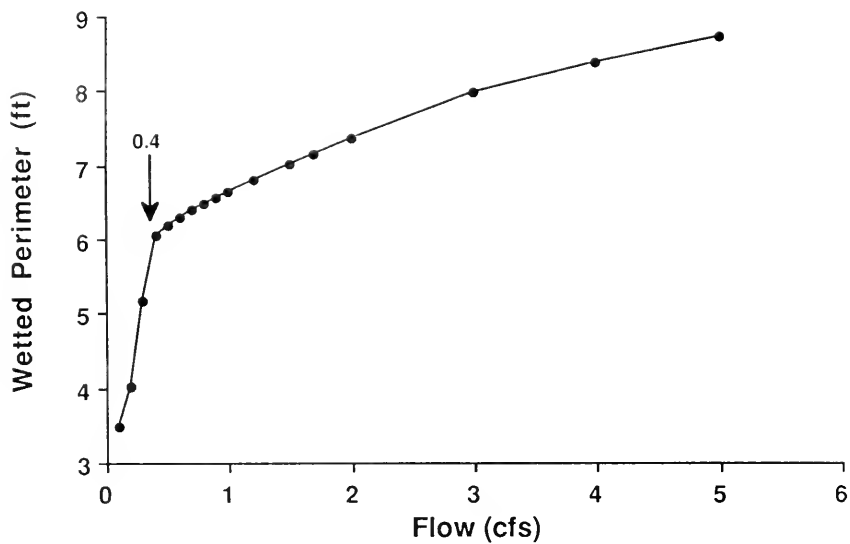


Figure 2-15. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Cabin Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to protect important habitat for the native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.4 cfs (290 A.F./yr)

STREAM NAME: Simpson Creek

STREAM REACH: From the headwaters to the mouth - 8.9 miles

LOCATION: Sec. 34, T14S, R12W to Sec. 36, T14S, R11W

DESCRIPTION OF STREAM REACH:

Simpson Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of approximately 9,280 ft. The stream flows in an easterly direction for about 8.9 miles to its juncture with Cabin Creek, a tributary to Big Sheep Creek. The only named tributary of Simpson Creek is Crystal Creek. The 10.8 square mile drainage is characterized by steep, heavily timbered slopes in the headwater region and rolling, sagebrush-grassland slopes in the lower reaches. Ownership of the drainage is shared by the USFS (45.7%), private individuals (28.6%), the BLM (24.0%) and the State of Montana (1.7%). The stream is bordered by a relatively broad riparian zone of willow, birch, grasses and sedges. The average gradient of the 5.5 ft wide channel is 48.9 ft/1,000 ft.

Lands within the Simpson Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by Jeep trail from Morrison Lake.

The BLM portion of the drainage is contained in a single grazing allotment which is managed on a rest-rotation basis. A BLM range evaluation found this allotment to be in fair condition in terms of soil erosion and in good to excellent vegetative condition, but undergoing a declining trend (BLM, 1980). A stream channel stability evaluation resulted in a fair rating for Simpson Creek, while a riparian zone inventory resulted in a good condition rating (BLM, 1980).

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Simpson Creek (T14S, R12W, Sec. 36BA and 25CD) was electrofished on August 3 and 20, 1982. Thirty-six westslope cutthroat trout, ranging from 3.0-6.5 inches, were captured. No other species were present.

No standing crop estimate could be derived for the study section due to a complete lack of recaptured fish. Only seven fish were marked on the August 3 electrofishing run, while 29 were captured on the August 20 recapture run, none of which bore a fin clip mark. Assuming an equal electrofishing efficiency on each run, the data indicate movement of fish through the study section. There is some indication that cutthroat trout in the Cabin Creek drainage utilize the headwater tributaries, which include Simpson Creek, on a seasonal basis (Lew Myers, BLM Biologist, Personal Communication).

BLM biologists collected cutthroat trout from the present study section in July, 1980 for meristic examination. These fish were found to be within

the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

WILDLIFE:

The Simpson Creek drainage supports mountain goat year-round and elk, mule deer and antelope from spring through fall. Other wildlife inhabiting the drainage include bobcat and sage grouse.

WETTED PERIMETER:

Cross-sectional data for Simpson Creek were collected in a 208 ft riffle sequence located at about stream mile 6.5 (T14S, R12W, Sec. 25CD). Approximately 34% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 0.6, 1.6 and 4.7 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-16. Lower and upper inflection points occur at about 0.4 and 0.7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for the native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.7 cfs (507 A.F./yr)

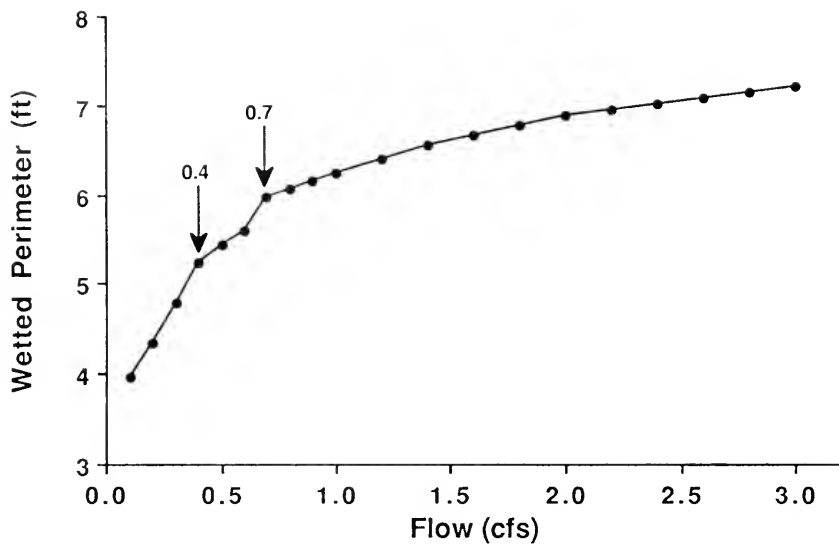


Figure 2-16. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Simpson Creek.

STREAM NAME: Deadman Creek

STREAM REACH: From Deadman Lake to the mouth - 9.3 miles

LOCATION: Sec. 18, T16S, R10W to Sec. 10, T15S, R10W

DESCRIPTION OF STREAM REACH:

Deadman Creek originates in the Bitterroot Mountains of southwest Montana and flows in a northerly direction for 17 miles before entering Big Sheep Creek, a tributary to the Red Rock River. The 25.5 square mile drainage is controlled by the USFS (88%), BLM (10%) and private landowners (2%). Deadman creek is approximately 10 feet wide and flows through a grassland/sagebrush landscape. The gradient averages 28 ft per 1,000 ft. The riparian zone in the upper portion of the drainage is generally composed of grasses and forbs with sparse woody species. In the lower reaches, clumps of willow become more frequent. Major tributaries include Pine and Little Deadman Creeks. The bottom substrate consists primarily of rubble and coarse gravel.

Lands within the Deadman Creek drainage are mainly used for livestock grazing, timber harvesting and recreation in the form of hunting and fishing. Access to the middle reaches of Deadman Creek is provided by an unimproved road. The remainder of the stream is accessible only by foot or horseback.

Naturally occurring high flows combined with the overuse of the riparian zone by cattle have led to stream bank erosion, the sedimentation of the stream channel and the elimination of bank vegetation along stretches of Deadman Creek. A road crossing the stream in its middle reaches has caused a widening of the channel and a possible increase in stream sedimentation.

GAME FISH PRESENT: Rainbow trout, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Deadman Creek was electrofished on July 25 and August 19, 1980. A total of 143 rainbow, cutthroat and rainbow x cutthroat hybrid trout, ranging from 4.0-12.7 inches, were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-14). Due to the varying degrees of hybridization between the two species present, a total trout estimate was calculated. This 1,000 ft section supported about 202 trout 4.0 inches and longer, weighing 23 pounds. This is a relatively productive stream considering its size and high elevation. The condition of the trout (length to weight ratio) was above average for streams surveyed in the Beaverhead National Forest.

Table 2-14. Estimated standing crop of trout in a 1,000 ft section of Deadman Creek (T15S, R10W, Sec. 22C) on July 25, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Cutthroat, rainbow and	4.0 - 5.9	116	
cutthroat x rainbow	6.0 - 9.9	83	
hybrid trout	10.0 - 12.7	3	
		202(±34)	23(±3)

The BLM collected seven trout from Deadman Creek for meristic analyses to determine the degree of hybridization within the population. A moderately high degree of hybridization was found between the native westslope cutthroat trout and introduced Yellowstone cutthroat and rainbow trout.

WILDLIFE:

The Deadman Creek drainage supports mule deer, elk and moose year-round and antelope and sage grouse from spring through fall. Other inhabitants of the drainage include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data were collected in a 98 ft riffle-run sequence of Deadman Creek in T15S, R10W, Sec. 22C. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 7.4, 10.3 and 14.8 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-17. Lower and upper inflection points occur at about 2.5 and 4.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4.5 cfs (3,258 A.F./yr)

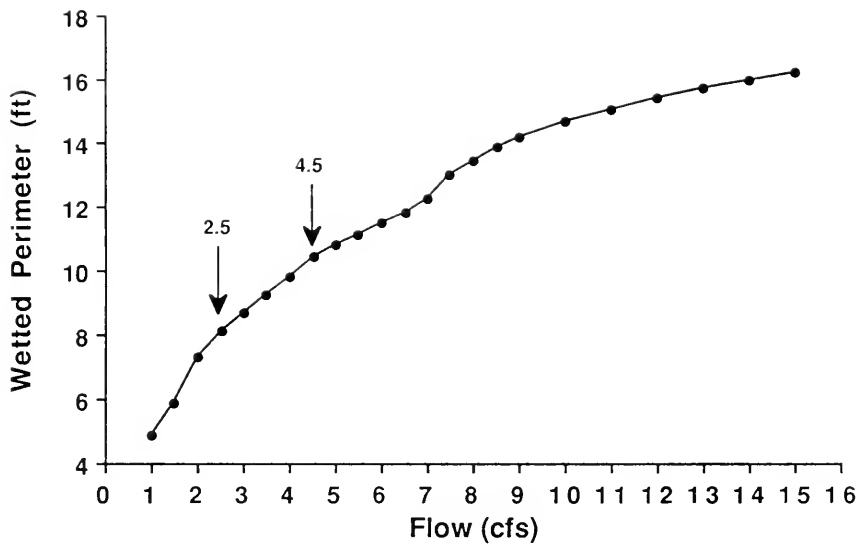


Figure 2-17. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Deadman Creek.

STREAM NAME: Big Sheep Creek

STREAM REACH: From the confluence of Cabin and Nicholia Creeks to the mouth
- 22.1 miles

LOCATION: Sec. 4, T15S, R10W to Sec. 10, T13S, R9W

DESCRIPTION OF STREAM REACH:

Big Sheep Creek originates at the confluence of Cabin and Nicholia Creeks in the Tendoy Mountains of southwest Montana and flows for 22.1 miles before entering the Red Rock River near the town of Dell. The drainage is characterized by steep, timbered limestone cliffs and grassland/sagebrush valleys and hillsides. The stream flows in a northeasterly direction through a floodplain vegetated with willow, alder, birch, grasses and forbs. The 295.5 square mile drainage is controlled by the USFS (57%), BLM (23%), private individuals (15%), and the State of Montana (5%). Major tributaries to Big Sheep Creek include Muddy, Cabin, Deadman and Nicholia Creeks. Several alpine lakes, including Deadman, Morrison and Harkness Lakes, dot the headwater area. The 20 ft wide channel has an average gradient of 8 ft/1,000 ft.

Lands within the drainage are primarily used for livestock grazing, hay production, logging, mining and recreation in the form of fishing, hunting, hiking and camping. Access is provided by a gravel road which parallels the stream for its entire length. Numerous secondary roads provide good access throughout the drainage. Cattle and sheep ranches are located in the lower and upper valley bottoms.

The lower four miles of Big Sheep Creek are severely dewatered during the irrigation season. Little of the stream's natural flow remains in the channel at its confluence with the Red Rock River. Most of the water enters the river through subsurface irrigation return. Another problem affecting the aquatic resource of lower Big Sheep Creek is the extremely high sediment loads that originate in the Muddy Creek drainage.

A USGS gage station located at stream mile 8.7 of Big Sheep Creek (below the mouth of Muddy Creek) was operated intermittently from 1936-1976. The mean annual flow for a 26-year period of record was 65.0 cfs. Mean monthly flows ranged from 42 cfs (for February) to 104 cfs (for June). A large portion of the flow originates from springs, which enter the creek at about stream mile 12. These springs provide about 56% of the flow during the early fall months (BLM, unpublished data).

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish.

FISHERY:

Two sections of Big Sheep Creek were electrofished on May 2 and 21, 1980. The upper 7,128 ft section was located above the confluence of Muddy Creek and below the numerous springs that feed the creek. The 6,600 ft long lower section was approximately eight miles downstream from the upper section and below the confluence of Muddy Creek. Game fish present in both sections were rainbow and brown trout and mountain whitefish. Mottled sculpin,

longnose dace and longnose sucker were the non-game species present. Table 2-15 summarizes the electrofishing data for both sections.

Table 2-15. Summary of electrofishing survey data collected in the upper 7,128 ft section (T14S, R10W, Sec. 15 center - 22 center) and the lower 6,600 ft section (T13S, R9W, Sec. 30C - T13S, R10W, Sec. 36A) of Big Sheep Creek on May 2 and 21, 1980.

Fish Species	Number Captured		Length Range (inches)	
	<u>Upper</u>	<u>Lower</u>	<u>Upper</u>	<u>Lower</u>
Brown trout	74	175	4.5 - 24.4	5.0 - 18.9
Rainbow trout	144	14	4.5 - 20.4	6.9 - 15.6
Mountain whitefish	-	-	-	-
Mottled sculpin	-	-	-	-
Longnose dace	-	-	-	-
Longnose sucker	-	-	-	-

The standing crops of trout in both sections were estimated using a mark-recapture method (Table 2-16). Both sections supported approximately 76 trout, weighing about 65 pounds, per 1,000 ft of stream. In the upper section, rainbow trout contributed 68% of the total numbers and 51% of the total biomass. In the lower section, the brown trout predominated. A rainbow trout estimate could not be obtained for the lower section due to the low numbers present.

Although the growth rates and standing crops of trout in both sections were similar, the condition of the fish (length to weight ratio) was considerably less in the lower section. Although more information is needed to explain these differences, the high sediment load below Muddy Creek may be a contributing factor.

Table 2-16. Estimated standing crops of trout in the upper 7,128 ft section (T14S, R10W, Sec. 15 center - 22 center) and the lower 6,600 ft section (T13S, R9W, Sec. 30C - T13S, R10W, Sec. 36A) of Big Sheep Creek on May 2, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	<u>Upper Section</u>	
		<u>Per 1,000 ft</u>	
		<u>Numbers</u>	<u>Pounds</u>
Rainbow trout	8.0 - 9.9	12	
	10.0 - 13.9	35	
	14.0 - 20.5	<u>5</u>	
		52(±16)	33(±10)
Brown trout	8.0 - 9.9	2	
	10.0 - 13.9	12	
	14.0 - 24.4	<u>10</u>	
		24(±9)	32(±14)
Total trout		76(±18)	65(±17)
Species	Length Group (inches)	<u>Lower Section</u>	
		<u>Per 1,000 ft</u>	
		<u>Numbers</u>	<u>Pounds</u>
Brown trout	9.0 - 9.9	4	
	10.0 - 13.9	54	
	14.0 - 18.9	<u>18</u>	
		76(±23)	63(±17)

WILDLIFE:

The Big Sheep Creek drainage supports year-round populations of antelope, bighorn sheep, mule deer, elk and sage grouse. Important winter range for deer and elk is provided. Other wildlife inhabiting the drainage are bobcat and mountain lion.

WETTED PERIMETER:

Cross-sectional data were collected in a 198 ft section of Big Sheep Creek in T13S, R10W, Sec. 36A. Five cross-sections were established to describe the various habitat types. The WETP program was calibrated to field data collected at flows of 57.3, 72.0 and 99.6 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section is shown in Figure 2-18. Lower and upper inflection points occur at about 14 and 48 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 48 cfs (34,750 A.F./yr)

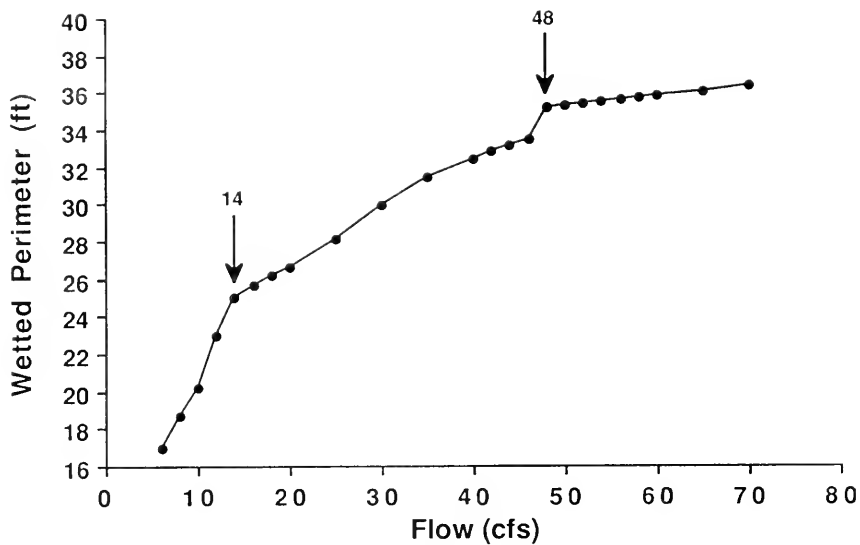


Figure 2-18. The relationship between wetted perimeter and flow for a single riffle cross-section in Big Sheep Creek.

STREAM NAME: Black Canyon Creek

STREAM REACH: From the headwaters to the mouth - 10.4 miles

LOCATION: Sec. 26, T11S, R15W to Sec. 35, T10S, R14W

DESCRIPTION OF STREAM REACH:

Black Canyon Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of about 8,880 ft. The stream flows in an east-northeasterly direction for approximately 10.4 miles to its confluence with Everson Creek, a tributary to Horse Prairie Creek. The 16.9 square mile drainage is heavily timbered in the headwater region and characterized by sagebrush-grassland communities in the lower elevations. Ownership of the drainage is shared by the USFS (49%), the BLM (27%), private individuals (15%) and the State of Montana (9%). The stream is bordered by a relatively broad riparian zone of willow, aspen, grasses and sedges and characterized by numerous areas of beaver activity. The average gradient of the 5 ft wide channel is 44.8 ft/1,000 ft.

Lands within the Black Canyon Creek drainage are utilized for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a dirt road which parallels the stream.

The BLM segment of the drainage is included in two grazing allotments which are managed on a rest-rotation basis. One of these allotments was evaluated as being in good condition. However, the other was rated as poor and undergoing a declining trend (BLM, 1980). A stream channel stability evaluation resulted in a fair rating for Black Canyon Creek, while a riparian zone survey resulted in a good rating (BLM, 1980).

CAME FISH PRESENT: Brook trout.

FISHERY:

A 1,000 ft section of Black Canyon Creek was electrofished on August 4 and 11, 1982. Two hundred fifty-one brook trout, ranging from 1.6-11.1 inches, were captured. The mottled sculpin was the only other species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-17). This 1,000 ft section supported an estimated 351 trout 3.5 inches and longer, weighing 35 pounds. Fish 6.0 inches and longer comprised 49% of the population. Black Canyon Creek provides an excellent small stream fishery for pan-size brook trout.

Table 2-17. Estimated standing crop of brook trout in a 1,000 ft section of Black Canyon Creek (T11S, R14W, Sec. 21BD) on August 4, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 4.4	127	
	4.5 - 6.4	95	
	6.5 - 11.1	<u>129</u>	
		351(±46)	35(±4)

WILDLIFE:

The Black Canyon Creek drainage supports elk and moose year-round and provides seasonal habitat for mule deer and antelope from spring through fall. Important elk winter range is located within the drainage. Other resident wildlife include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data for Black Canyon Creek were collected in a 146 ft riffle sequence at stream mile 5.2 (T11S, R14W, Sec. 21BD). Approximately 65% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 3.6, 10.6 and 17.1 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-19. Lower and upper inflection points occur at about 1.5 and 2.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.5 cfs (1,810 A.F./yr)

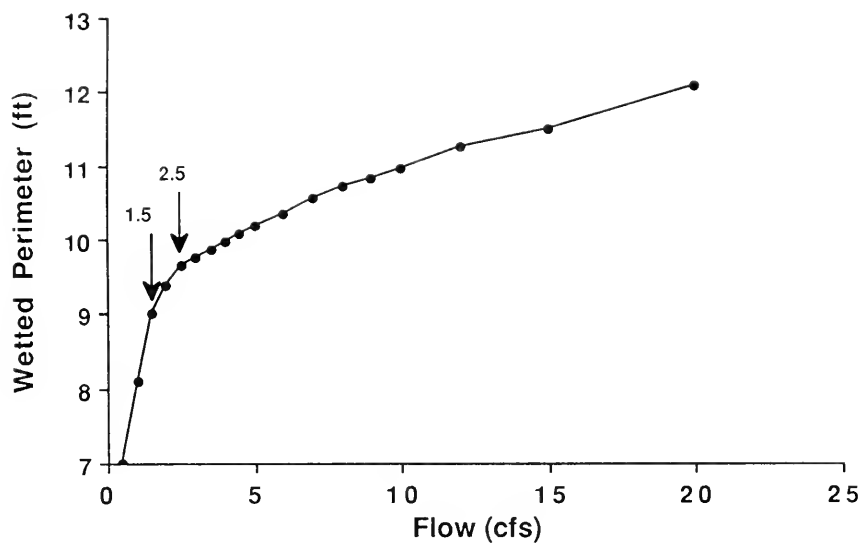


Figure 2-19. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Black Canyon Creek.

STREAM NAME: Shenon Creek

STREAM REACH: From the headwaters to the BLM boundary in Sec. 25, T10S, R14W
- 6.3 miles

LOCATION: Sec. 2, T11S, R13W to Sec. 25, T10S, R14W

DESCRIPTION OF STREAM REACH:

Shenon Creek originates on the east slope of the Beaverhead Mountains at an elevation of about 8,760 ft. The stream flows in a northwesterly direction for 8.9 miles to its junction with Horse Prairie Creek, a tributary to Clark Canyon Reservoir. The 8.6 square mile drainage is characterized by timbered slopes in the headwater region and sagebrush-grassland communities in the lower elevations. Ownership of the Shenon Creek drainage is shared by the BLM (61%), private individuals (21%) and the State of Montana (18%). The stream is bordered by a relatively broad riparian zone consisting of willow, birch, aspen, grasses and sedges. The average gradient of the 3.0 ft wide channel is 66.4 ft/1,000 ft.

Lands within the Shenon Creek drainage are used for cattle grazing and outdoor recreation, primarily hunting. Access is provided by a dirt road which parallels the stream.

The BLM portion of the drainage is included in a single grazing allotment which is managed on a rest-rotation basis. A BLM evaluation found the allotment to be in good condition both in terms of vegetation and soil erosion. However, the range was undergoing a declining trend (BLM, 1980).

A stream channel stability evaluation resulted in a poor rating for Shenon Creek, while a riparian zone inventory resulted in an unsatisfactory rating (BLM, 1980). The poor ratings for Shenon Creek were due to large percentages of active erosion along the stream banks.

GAME FISH PRESENT: Brook trout, westslope cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Shenon Creek was electrofished on July 7 and 27, 1982. Sixteen brook trout, ranging from 4.2-7.3 inches, and 10 cutthroat and rainbow x cutthroat hybrid trout from 2.9-6.8 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-18). The low estimate of eight fish per 1,000 ft is probably due to the generally poor condition of fish habitat in Shenon Creek, as indicated by eroding banks and the degraded riparian zone. The poor status of the fish habitat has been attributed to cattle grazing practices along the stream (BLM, 1980).

Table 2-18. Estimated standing crop of brook trout in a 1,000 ft section of Shenon Creek (T10S, R13W, Sec. 32BB) on July 7, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 7.3	8(±3)	1(±0)

Meristic examination of cutthroat trout from Shenon Creek revealed that some of the fish were within the range of characteristics used to describe westslope cutthroat trout (Behnke, 1979 and Roscoe, 1974), while other specimens had some degree of hybridization with rainbow trout. The hybridization of native cutthroat trout with introduced rainbow trout is one of the major factors associated with the marked decline of native cutthroat trout in Montana.

WILDLIFE:

The Shenon Creek drainage supports mule deer year-round, elk in winter and antelope and sage grouse from spring through fall. Other wildlife inhabiting the drainage include bobcat.

WETTED PERIMETER:

Cross-sectional data for Shenon Creek were collected in a 184 ft riffle sequence at stream mile 2.9 (T10S, R13W, Sec. 32AA). Approximately 47% of the drainage was located above this site. The WETP program was calibrated to field data collected at flows of 0.7, 1.0 and 1.7 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-20. A prominent upper inflection point occurs at about 0.4 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population, which includes westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.4 cfs (290 A.F./yr)

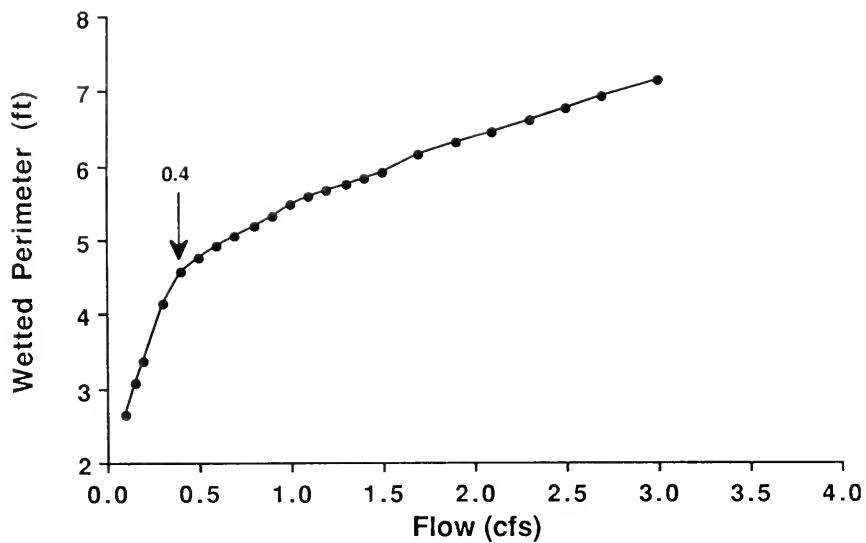


Figure 2-20. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Shenon Creek.

STREAM NAME: Frying Pan Creek

STREAM REACH: From the headwaters to the mouth - 2.4 miles

LOCATION: Sec. 22, T10S, R15W to Sec. 24, T10S, R15W

DESCRIPTION OF STREAM REACH:

Frying Pan Creek originates at the confluence of North and South Frying Pan Creeks on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of about 8,400 ft. The stream flows in an east-northeasterly direction for 2.4 miles before entering Trail Creek, a tributary to Horse Prairie Creek. Named tributaries to Frying Pan Creek include the North and South Forks of Frying Pan Creek and Trapper Creek. The 6.8 square mile drainage is heavily timbered in the upper elevations and is characterized by sage and grassland communities in the lower elevations. The stream is bordered by a riparian zone consisting of willow, alder, aspen, grasses and sedges. The 8.5 ft wide channel has an average gradient of 18.9 ft/1,000 ft. Ownership of the drainage is shared by the USFS (42%), the State of Montana (29%), private individuals (21%) and the BLM (8%).

Lands within the Frying Pan Creek drainage are used for cattle grazing, timber harvesting, mining and outdoor recreation in the form of hunting and fishing. Access is provided by a dirt road which crosses the stream near the juncture of the North and South Forks.

Portions of two grazing allotments are contained in the BLM controlled segment of the drainage. These allotments are managed on a seasonal and rest-rotation basis. A BLM evaluation of these allotments found them to be in excellent vegetative shape with no indication of soil erosion.

Exploratory mining for the radioactive mineral thorium has occurred in the Frying Pan Creek drainage in the past. A small abandoned settlement on the South Fork of Frying Pan Creek, called Thorium City, was erected to house the miners and is presently still standing.

No logging was occurring on USFS lands within the drainage at the time of the present study. However, a small timber sale is planned for 1984.

A stream channel stability evaluation resulted in a fair rating for Frying Pan Creek. The riparian zone was rated in good condition but far below its potential due to overgrazing (BLM, 1980).

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Frying Pan Creek was electrofished on July 30 and August 10, 1982. One hundred fifteen westslope cutthroat trout, ranging from 2.0-9.3 inches, were captured. No other species were present.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-19). The section supported 474 trout 2.5 inches and longer, weighing 25 pounds. Fish 6 inches and longer comprised

17% of the estimated population. Fish condition (length to weight ratio) was excellent.

Table 2-19. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Frying Pan Creek (T10S, R15W, Sec. 22CA) on July 30, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	2.5 - 6.9	447	
	7.0 - 9.3	27	
		474(±224)	25(±10)

Meristic examination of representative fish collected from Frying Pan Creek found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the Upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce the native cutthroat population of the Upper Missouri drainage.

WILDLIFE:

The Frying Pan Creek drainage supports moose year-round and elk, mule deer and antelope from spring through fall. Other resident wildlife include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data for Frying Pan Creek were collected in an 83 ft riffle sequence located at about stream mile 2.0 (T10S, R15W, Sec. 22CA). Approximately 67% of the drainage area is located above this site. Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 2.2, 4.8 and 9.8 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-21. Lower and upper inflection points occur at 1.0 and 1.6 cfs, respectively.

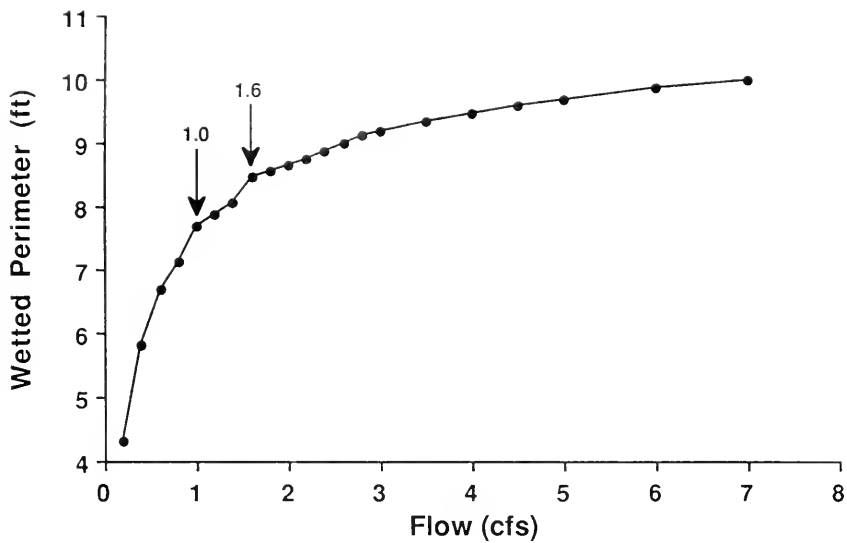


Figure 2-21. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Frying Pan Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to protect important habitat for native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.6 cfs (1,158 A.F./yr)

STREAM NAME: Trapper Creek

STREAM REACH: From the headwaters to the mouth - 5.4 miles

LOCATION: Sec. 32, T10S, R15W to Sec. 23, T10S, R15W

DESCRIPTION OF STREAM REACH:

Trapper Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of approximately 8,600 ft. The stream flows in an east-northeasterly direction for 5.4 miles to its confluence with Frying Pan Creek, a tributary to Trail Creek which flows into Horse Prairie Creek. The 4.9 square mile drainage is characterized by heavily timbered slopes in the headwater region and sagebrush-grassland communities in the lower elevations. Ownership of the Trapper Creek drainage is shared by the USFS (45%), private individuals (31%), the BLM (14%) and the State of Montana (10%). The stream is bordered by a narrow riparian zone of willow, aspen, alder, grasses and sedges. The average gradient of the 3.5 ft wide channel is 74.2 ft/1,000 ft.

Lands within the Trapper Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a Jeep trail which crosses the stream.

The BLM portion of the drainage is included in a single grazing allotment which is utilized on a rest-rotation basis. A BLM evaluation found this allotment to be in excellent vegetative condition with no indication of soil erosion and currently in an improving trend (BLM, 1980). A stream channel stability and riparian zone evaluation resulted in fair ratings for Trapper Creek.

GAME FISH PRESENT: Westslope cutthroat trout, brook trout.

FISHERY:

A 1,000 ft section of Trapper Creek was electrofished on July 30 and August 10, 1982. Thirty westslope cutthroat trout, ranging from 2.2-7.7 inches, and 6 brook trout from 3.0-5.3 inches were captured.

The standing crop of westslope cutthroat trout was estimated using a mark-recapture method (Table 2-20). The section supported 33 cutthroat trout 4.0 inches and longer, weighing three pounds. Fish condition (length to weight ratio) was excellent.

Table 2-20. Estimated standing crop of westslope cutthroat trout in a 1,000 ft section of Trapper Creek (T10S, R15W, Sec. 34BD) on July 30, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Westslope cutthroat trout	4.0 - 7.7	33(±12)	3(±1)

Meristic examination of representative fish collected from Trapper Creek found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the Upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce the native cutthroat population of the Upper Missouri drainage.

WILDLIFE:

The Trapper Creek drainage supports year-round populations of mule deer, elk, mountain goat and some moose. Other inhabitants of the drainage include bobcat, mountain lion and black bear.

WETTED PERIMETER:

Cross-sectional data for Trapper Creek were collected in a 224 ft riffle sequence at about stream mile 2.5 (T10S, R15W, Sec. 34BD). Approximately 63% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 0.9, 3.7 and 12.1 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-22. A prominent upper inflection point occurs at about 0.7 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to protect important habitat for westslope cutthroat trout; to maintain the existing resident brook trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.7 cfs (507 A.F./yr)

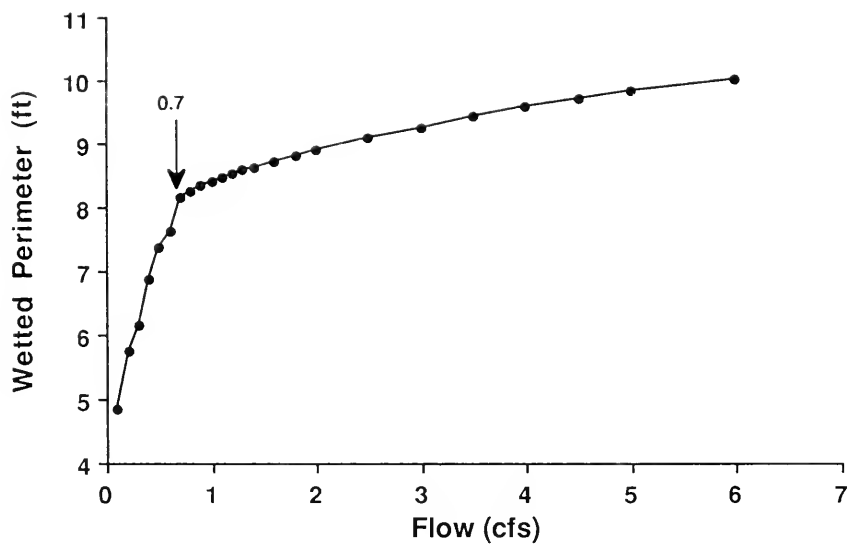


Figure 2-22. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Trapper Creek.

STREAM NAME: Bear Creek

STREAM REACH: From the headwaters to the BLM boundary - 5.5 miles

LOCATION: Sec. 21, T11S, R15W to Sec. 26, T10S, R15W

DESCRIPTION OF STREAM REACH:

Bear Creek originates on the east slope of the Continental Divide in the Beaverhead Mountains at an elevation of approximately 8,880 ft. The stream flows in an east-northeasterly direction for about 9.3 miles to its juncture with Trail Creek, a tributary to Horse Prairie Creek. The 19.1 square mile drainage is typified by heavily timbered slopes in the upper elevations and sagebrush-grassland communities in the lower portions. Ownership of the drainage is shared by the USFS (66%), private individuals (16%), the BLM (12%) and the State of Montana (6%). The only named tributary to Bear Creek is Bear Gulch. The average gradient of the 8.0 ft wide channel is 48.9 ft/1,000 ft. The stream is bordered by a relatively broad riparian zone of willow, alder, aspen, grasses and sedges and supports some beaver activity.

Lands within the Bear Creek drainage are used for cattle grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a Jeep trail.

The BLM portion of the Bear Creek drainage is included in a single grazing allotment which is managed on a rest-rotation basis. A BLM evaluation found this allotment to be in excellent vegetative condition with no indication of soil erosion, and is currently in an improving trend.

A stream channel stability evaluation resulted in a fair rating for Bear Creek, while a riparian inventory rated the stream in good condition (BLM, 1980).

GAME FISH PRESENT: Brook trout, westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Bear Creek was electrofished on August 4 and 10, 1982. Seventy-three brook trout, ranging from 2.3-9.7 inches, and 36 cutthroat trout from 2.9-8.4 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-21). No estimate of cutthroat trout could be derived due to a lack of sufficient recaptured fish to insure statistical reliability. The section supported 65 brook trout 5.0 inches and longer, weighing 7 pounds. Fish 6.0 inches and longer comprised 52% of the estimated population. Brook trout condition (length to weight ratio) was excellent and well above average when compared to other populations in the Beaverhead River drainage.

Table 2-21. Estimated standing crop of brook trout in a 1,000 ft section of Bear Creek (T10S, R15W, Sec. 35BB) on August 4, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 9.7	65(±24)	7(±3)

None of the Bear Creek cutthroat trout were collected for meristic determination of strain due to the low numbers of fish collected during the recapture run. Meristic examination of cutthroat trout from Frying Pan and Trapper Creeks, Trail Creek tributaries immediately adjacent to Bear Creek, resulted in their classification as the westslope strain. Due to the proximity of Bear Creek to these headwater tributaries, it is likely that the Bear Creek cutthroat trout represent another westslope population.

WILDLIFE:

The Bear Creek drainage seasonally supports elk, antelope and mule deer from spring through fall. Other wildlife inhabiting the drainage include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data for Bear Creek were collected in a 118 ft riffle sequence located at about stream mile 4.0 (T10S, R15W, Sec. 26CD). Approximately 67% of the drainage was located above this site. The WETP program was calibrated to field data collected at flows of 4.8, 10.5 and 15.6 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-23. Lower and upper inflection points occur at about 2.5 and 6.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing brook trout population; to protect important habitat of a probable population of westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 6.5 cfs (4,706 A.F./yr)

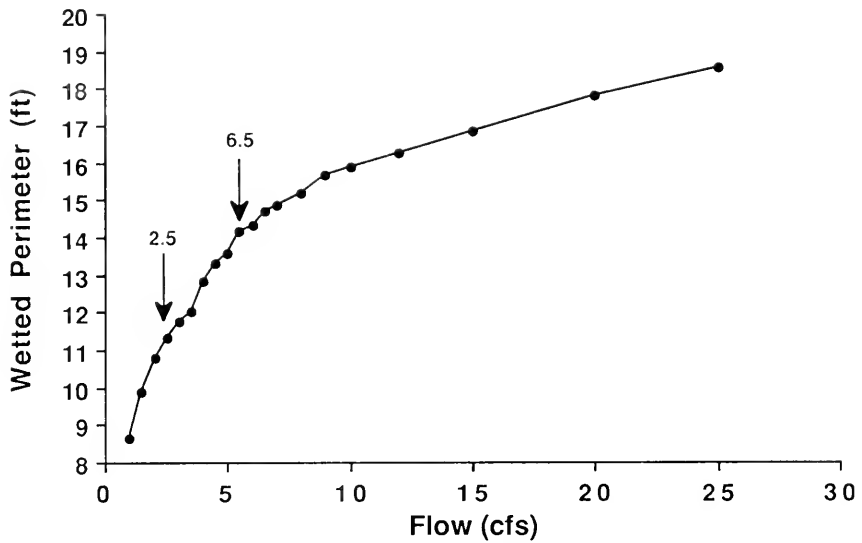


Figure 2-23. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Bear Creek.

STREAM NAME: Rape Creek

STREAM REACH: From the headwaters to the storage reservoir in Sec. 4, T10S, R13W - 7.0 miles

LOCATION: Sec. 26, T10S, R13W to Sec. 4, T10S, R13W

DESCRIPTION OF STREAM REACH:

Rape Creek originates on the east slope of the Beaverhead Mountains at an elevation of approximately 8,720 ft. The stream flows in a northwesterly direction for 7.0 miles to a storage reservoir for the Payment Ditch from Horse Prairie Creek. The 8.0 square mile drainage is controlled by the BLM (50%), the State of Montana (25%) and private individuals (25%). The stream is bordered by a narrow riparian zone of willow, aspen, grasses and sedges and is characterized by a high percentage of active bank erosion. The average gradient of the 2.5 foot wide channel is 70.3 ft/1,000 ft.

Lands within the Rape Creek drainage are used for cattle grazing and outdoor recreation, primarily hunting. Access is provided by a Jeep trail.

The BLM portion of the drainage is included in a single grazing allotment which is managed on a rest-rotation basis. A BLM evaluation found this allotment to be in good condition in terms of vegetation and soil erosion. However, the range is in a declining trend (BLM, 1980). A stream channel stability evaluation resulted in a poor rating for Rape Creek, while a riparian inventory rated the stream in unsatisfactory condition (BLM, 1980). The poor ratings for Rape Creek were due to a large percentage of active bank erosion along the stream channel.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 1,000 ft section of Rape Creek (T10S, R13W, Sec. 21DB) was electro-fished on July 7 and August 19, 1982. Thirty-six westslope cutthroat trout from 2.3-6.3 inches were captured. No other species were present. The standing crop of westslope cutthroat trout could not be estimated due to a lack of sufficient recaptures to insure statistical reliability of the estimate.

BLM biologists collected cutthroat trout from Rape Creek in July, 1980 for meristic evaluation. These fish were found to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

WILDLIFE:

The Rape Creek drainage supports mule deer year-round, antelope from spring through fall and provides winter range for elk. Other wildlife inhabiting the drainage include sage grouse and bobcat.

WETTED PERIMETER:

Cross-sectional data for Rape Creek were collected in a 107 ft riffle sequence at about stream mile 3.7 (T10S, R13W, Sec. 21DB). Approximately 38% of the drainage was located above this site. The WETP program was calibrated to field data collected at flows of 0.6, 1.1 and 1.7 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-24. A prominent upper inflection point occurs at a flow of 0.4 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for native westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.4 cfs (290 A.F./yr)

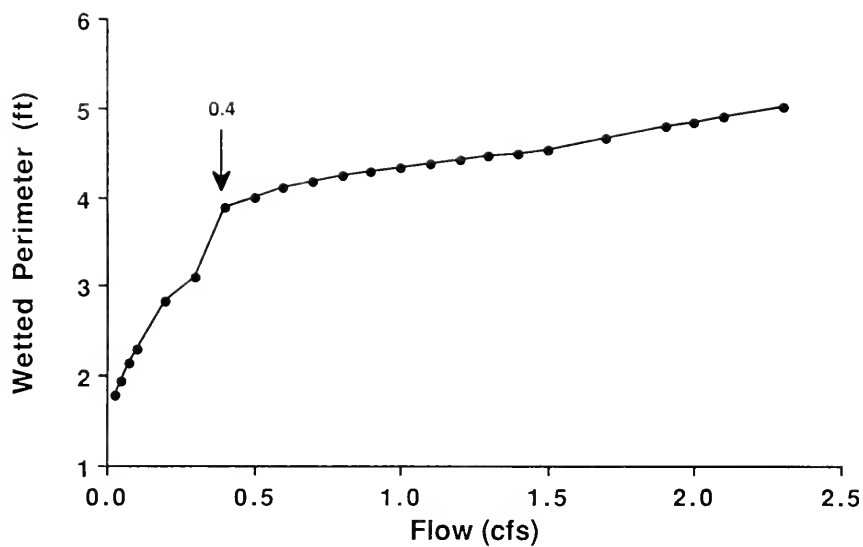


Figure 2-24. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Rape Creek.

STREAM NAME: Bloody Dick Creek

STREAM REACH: From the Swift Lake outlet to the mouth - 27.1 miles

LOCATION: Sec. 16, T8S, R16W to Sec. 32, T9S, R13W

DESCRIPTION OF STREAM REACH:

Bloody Dick Creek originates at Swift Lake in the Bitterroot Mountains of southwest Montana and flows in a southeasterly direction for 27.1 miles before joining Horse Prairie Creek, a tributary to Clark Canyon Reservoir. The stream meanders through a riparian zone consisting of dense willows, grasses and forbs. The gradient of the 30 ft wide channel averages 11 ft/1,000 ft. Land ownership of this 135.5 square mile drainage is shared by the USFS (70%), private individuals (21%), BLM (6%), and the State of Montana (3%). Major tributaries to Bloody Dick Creek include Selway, Park, Lake, Eunice and U-Turn Creeks. Major lakes within the drainage are Selway, Swift and Reservoir.

Lands within the Bloody Dick drainage are used for hay production, livestock grazing, timber harvesting, mining and recreational activities such as fishing, hunting and camping. Access to the drainage is provided by an unimproved gravel road paralleling the stream. A campground on Reservoir Lake is heavily used during the summer months and big game season.

Historically, mining for gold and silver has occurred in the lower Bloody Dick valley. Productivity of the mining operations is unknown.

Environmental problems within the Bloody Dick drainage are mainly related to livestock grazing. Grazing within the riparian zone along portions of the stream has caused loss of vegetative cover, widening of the channel and minor erosion and mass wasting on outside meanders. The lower reaches of Bloody Dick Creek are dewatered during the summer irrigation season. Logging on private land in 1978 caused considerable erosion on a mile of the west slope bordering the stream. Stream channel stability was evaluated by the BLM as good in 1977. Excessive peak flows are believed to be impacting the lower watershed.

The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the Bloody Dick drainage at 50,800 acre-feet (70.2 cfs).

GAME FISH PRESENT: Brook trout, rainbow trout, mountain whitefish.

FISHERY:

A 3,540 ft section of Bloody Dick Creek was electrofished on July 24 and August 7, 1974 (Peterson, 1975). Game fish captured in descending order of abundance were brook trout, rainbow trout and mountain whitefish. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-22.

Table 2-22. Summary of electrofishing survey data collected for a 3,540 ft section of Bloody Dick Creek (T9S, R15W, Sec. 26A-36B) on July 24 and August 7, 1974.

Fish Species	Number Captured	Length Range (inches)
Brook trout	568	3.5 - 12.5
Rainbow trout	168	2.9 - 14.9
Mountain whitefish	80	9.1 - 18.3
Mottled sculpin	-	-

The total salmonid standing crop was estimated using a mark-recapture method (Table 2-23). The stream supported about 618 game fish, weighing 102 pounds, per 1,000 ft. Brook trout, the predominant species, comprised about 78% of the total numbers and 53% of the total biomass. Although trout were abundant in Bloody Dick Creek, their condition (length to weight ratio) was below average for streams surveyed in the area. Of the streams surveyed in the Beaverhead National Forest, Bloody Dick Creek supported one of the highest populations of game fish.

Table 2-23. Estimated standing crop of game fish in a 3,540 ft section of Bloody Dick Creek (T9S, R15W, Sec. 26A-36B) on July 24, 1974. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	254	
	6.0 - 9.9	218	
	10.0 - 12.5	9	
		481(±99)	54(±8)
Rainbow trout	4.0 - 5.9	69	
	6.0 - 9.9	25	
	10.0 - 14.9	6	
		100(±33)	12(±2)
Mountain whitefish	9.1 - 14.9	30	
	15.0 - 18.3	7	
		37(±10)	36(±9)
Total game fish		618(±105)	102(±11)

WILDLIFE:

The Bloody Dick Creek drainage supports moose, mule deer and elk year-round. Important winter range for these three species is located within the drainage. Antelope are seasonal residents from spring through fall. Other resident wildlife include black bear, bobcat and lynx.

WETTED PERIMETER:

Cross-sectional data were collected in a 66 ft section of Bloody Dick Creek in T9S, R15W, Sec. 14C. Five cross-sections defining the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 20.0, 123.3 and 209.3 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-25. An upper inflection point occurs at about 20 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 20 cfs (14,479 A.F./yr)

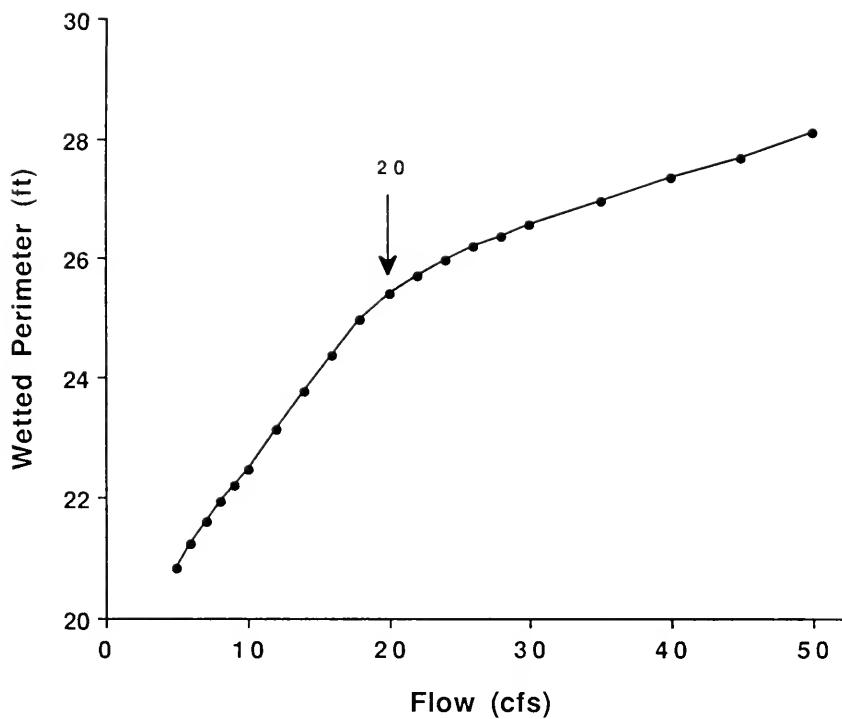


Figure 2-25. The relationship between wetted perimeter and flow for a single riffle cross-section in Bloody Dick Creek.

STREAM NAME: Browns Canyon Creek

STREAM REACH: From the headwaters to the mouth - 10.2 miles

LOCATION: Sec. 1, T8S, R14S to Sec. 15, T9S, R13W

DESCRIPTION OF STREAM REACH:

Browns Canyon Creek originates in the Big Hole Divide near Painter Peak and flows southeast for 10.2 miles before entering Painter Creek. Waters of Browns Canyon Creek eventually enter Clark Canyon Reservoir. The upper half of the approximate 9 square mile drainage is within the Beaverhead National Forest, while the lower stream passes through private and some BLM controlled lands. The creek is dewatered below the Forest Service boundary for irrigation.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 300 ft section of Browns Canyon Creek at about stream mile 6 was electrofished in 1986. Here, the creek passes through a mixed aspen, conifer, willow and grass vegetative type. Channel gradient is relatively low (near one percent) and the streambed is comprised of gravel and sand. The predominant land use along this stretch is cattle grazing.

The only game fish captured was the westslope cutthroat trout. Analyses performed by the University of Montana Genetics Laboratory found this population to be genetically pure.

A population estimate conducted in the above section in September, 1986 found 1,126 westslope cutthroat trout 3.0 inches and longer per mile, with 405 of these 6.0 inches and longer. The cutthroat captured averaged 4.8 inches in length.

WILDLIFE:

The Browns Canyon Creek drainage supports elk year-round, providing key winter range for this species. Moose are present year-round and mule deer from spring through fall. Other inhabitants include black bear, bobcat, coyote and three species of mountain grouse (ruffed, blue and Franklin's).

Geese and ducks are found along the lower portion of the creek. Birds of prey, particularly rough-legged hawks and bald and golden eagles, are often seen in the lower drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.3 cfs (1,665 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Browns Canyon Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 43% of the average annual flow is being requested for those Beaverhead-Red Rock River tributaries having high fishery values. An average annual flow of 5.3 cfs was estimated by the USGS for Browns Canyon Creek. An instream flow of 2.3 cfs is, therefore, requested.

STREAM NAME: Medicine Lodge Creek

STREAM REACH: From the confluence of Bear Canyon to the mouth - 33.1 miles

LOCATION: Sec. 30, T13S, R11W to Sec. 10, T10S, R11W

DESCRIPTION OF STREAM REACH:

Medicine Lodge Creek drains a narrow valley bordered on the east by the Tendoy Mountains and on the west by an offshoot of the Bitterroot Mountains. The stream flows for approximately 36 miles before entering Horse Prairie Creek, a tributary to Clark Canyon Reservoir. Medicine Lodge Creek meanders in a northerly direction through a floodplain of dense willows, grasses and forbs. The 20 ft wide channel has an average gradient of approximately 10.5 ft per 1,000 ft. The drainage is characterized by an open grassland/sagebrush valley surrounded by timbered slopes. Major tributaries to Medicine Lodge Creek include Dad, Craver, Law, Morrison, Poole, Hansen and Warm Springs Creeks. Numerous lakes and springs dot the upper drainage. The 188 square mile drainage is controlled by the USFS (42%), BLM (29%), private individuals (23%) and the State of Montana (5%).

Lands within the Medicine Lodge drainage are primarily used for livestock grazing, hay production, recreation in the form of hunting and fishing, and, historically, mining. Access is provided by a gravel road paralleling the stream for its entire length.

The severe dewatering that occurs during the summer irrigation season is the greatest threat to the aquatic resource of Medicine Lodge Creek. A series of irrigation ditches throughout the drainage reduce the natural flow to a trickle at its confluence with Horse Prairie Creek. Overuse of portions of the riparian zone by livestock has resulted in the loss of streambank cover, has increased bank erosion and has led to the widening of the channel. Extensive deposits of sediment occur in riffle and spawning areas of the stream.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Medicine Lodge Creek was electrofished on July 31 and August 18, 1980. Forty-nine brook trout, ranging from 3.0-12.9 inches, and 33 rainbow trout from 4.5-12.4 inches were captured. The mottled sculpin was the only non-game species present.

The standing crops of brook and rainbow trout were estimated using a mark-recapture method (Table 2-24). This 1,000 ft section supported a total population of about 165 trout, weighing 43 pounds. The brook trout was the predominant game species, comprising 77% of the total trout numbers and biomass. Of the streams electrofished in the Red Rock-Beaverhead drainages, Medicine Lodge Creek supported one of the highest standing crops of trout. There is a potential for an excellent fishery throughout Medicine Lodge Creek if adequate instream flows were maintained.

Table 2-24. Estimated standing crop of trout in a 1,000 ft section of Medicine Lodge Creek (T10S, R12W, Sec. 25A) on July 31, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	22	
	6.0 - 9.9	71	
	10.0 - 12.9	<u>34</u>	
		127(±58)	33(±15)
Rainbow trout	4.5 - 5.9	16	
	6.0 - 9.9	15	
	10.0 - 12.4	<u>7</u>	
		38(±8)	10(±2)
Total trout		165(±59)	43(±15)

WILDLIFE:

The Medicine Lodge Creek drainage supports elk, mule deer, moose and antelope year-round. Other wildlife inhabiting the drainage include black bear, bobcat and mountain lion.

WETTED PERIMETER:

Cross-sectional data for Medicine Lodge Creek were collected in an 84 ft riffle-pool sequence located in T10S, R12W, Sec. 25A. Five cross-sections were placed within the sequence. The WETP program was calibrated to field data collected at flows of 14.5, 28.8 and 59.8 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-26. A predominant upper inflection point occurs at a flow of about 10 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

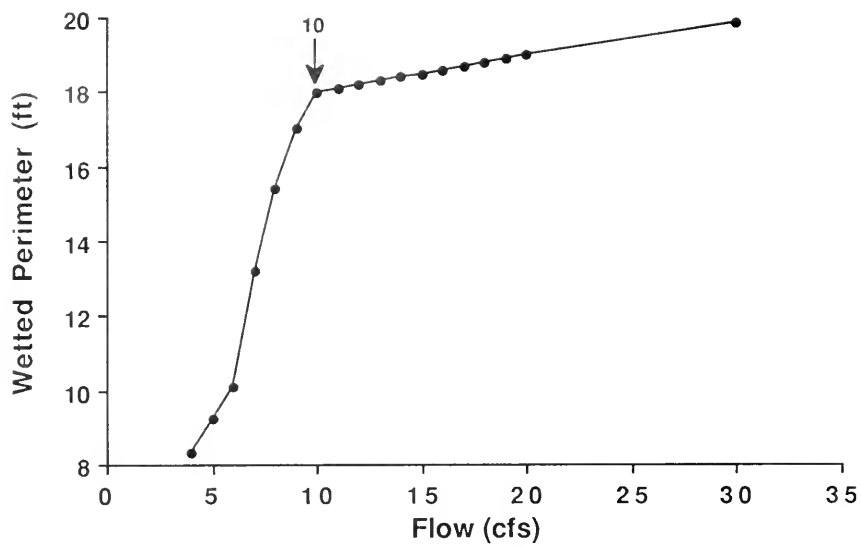


Figure 2-26. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Medicine Lodge Creek.

STREAM NAME: Horse Prairie Creek

STREAM REACH: From the headwaters to the mouth - 48.5 miles

LOCATION: Sec. 24, T12S, R13W to Sec. 11, T10S, R11W

DESCRIPTION OF STREAM REACH:

Horse Prairie Creek arises at the Continental Divide in the Bitterroot Mountains of southwest Montana and flows in a northeasterly direction for 48.5 miles before entering Clark Canyon Reservoir, 20 miles south of Dillon, Montana. The headwater portion of the 661 square mile drainage is characterized by conifer covered slopes and alpine plant communities. At lower elevations open grassland/sagebrush benches, sparsely forested foothills and irrigated hay pastures predominate. Ownership of the drainage is shared by the USFS (40%), private individuals (27%), BLM (26%) and the State of Montana (7%). The riparian zone is primarily vegetated with willow, alder, grasses, sage and forbs, with cottonwoods becoming prevalent along the lower few miles of stream. Major tributaries include Medicine Lodge, Bloody Dick, Trail, Jeff Davis, Painter and Nip and Tuck Creeks. Average gradient of Horse Prairie Creek is approximately 17 ft/1,000 ft. The width of the channel varies considerably from the headwaters to the mouth, averaging 55 ft in its lower reaches.

Lands within the Horse Prairie drainage are used primarily for winter cattle grazing and hay production. Other uses include logging, recreation in the form of fishing, hunting and camping, and, historically, mining. Extensive mining in the Jeff Davis drainage began in the 1800's and continued through the mid-1940's (Lyden, 1948). An estimated \$100,000 in gold was recovered by dry land dredging. A paved county highway and several unimproved gravel roads parallel the stream for the majority of its length.

The removal of water from Horse Prairie Creek for the irrigation of hayfields has severely altered the natural channel and its flow. On the lower 15 miles of stream, approximately 12 ditch systems divert water from the natural channel. These systems irrigate a valley approximately six miles wide. In order to construct and maintain the numerous diversions and ditches, the streambed has been extensively altered, ripped and relocated. Only in its lower two miles does the creek again flow in its natural channel. As a result of this use, the stream is severely dewatered during the growing season. In some years, total dewatering occurs.

A gage station on upper Horse Prairie Creek at stream mile 24.6 was operated by the USGS from 1946-53. The mean annual flow for the 7 years of record was 109.5 cfs. Mean monthly flows ranged from 29 cfs (for January) to 375 cfs (for June). Water to irrigate about 14,000 acres is diverted above this station. The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the Horse Prairie drainage at 120,300 acre-feet (166 cfs).

GAME FISH PRESENT: Brown trout, brook trout, rainbow trout.

FISHERY:

A 7,590 ft section of Horse Prairie Creek was electrofished on April 26 and May 3, 1972. Game fish captured in descending order of abundance were brown, brook and rainbow trout. Common and longnose suckers and mottled sculpin were the non-game species present (Table 2-25).

Table 2-25. Summary of electrofishing survey data collected for a 7,590 ft section of Horse Prairie Creek (T10S, R11W, Sec. 8) on April 26 and May 3, 1972.

Fish Species	Number Captured	Length Range (inches)
Brown trout	165	6.7 - 24.3
Brook trout	31	6.7 - 14.1
Rainbow trout	15	7.8 - 18.8
Common sucker	2,813	-
Longnose sucker	421	-

The standing crop of trout was estimated using a mark-recapture method (Table 2-26). This section supported approximately 41 trout, weighing a total of 46 pounds, per 1,000 ft of stream. Brown trout, the predominant species, comprised 73% and 85% of the total trout numbers and biomass, respectively. Eighty percent of the brown trout were 13 inches and longer, with each weighing an average of 1.3 pounds. Condition (length to weight ratio) of all trout species was considered below average for a stream of this size. The abundant sucker population in the section reflects an influx of spawners from Clark Canyon Reservoir.

In addition to supporting resident trout populations, Horse Prairie Creek provides spawning habitat for both wild brown and rainbow trout inhabiting Clark Canyon Reservoir. Electrofishing of a short (1,000 ft) section of lower Horse Prairie Creek in April, 1988 yielded 68 rainbow trout spawners. Numerous redds were also observed in riffle areas throughout the study section.

Table 2-26. Estimated standing crop of trout in a 7,590 ft section of Horse Prairie Creek (T10S, R11W, Sec. 8) on April 26, 1972. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	8.0 - 12.9	6	
	13.0 - 16.9	19	
	17.0 - 24.3	5	
		30(±4)	39(±5)
Brook trout	6.7 - 14.1	7(±3)	4(±1)
Rainbow trout	7.8 - 18.8	4(±1)	3(±1)
Total trout		41(±5)	46(±5)

WILDLIFE:

The Horse Prairie Creek drainage supports year-round populations of antelope, moose, mule deer and elk. Other wildlife inhabitants include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data were collected in an 81 ft section of Horse Prairie Creek near stream mile 2.0 (T10S, R11W, Sec. 9A). Five cross-sections defining the various habitat types were established. The WETP program was calibrated to field data collected at flows of 37.6, 127.9 and 198.0 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-27. Lower and upper inflection points occur at flows of about 20 and 36 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect spawning habitat for brown and rainbow trout inhabiting Clark Canyon Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 36 cfs (26,063 A.F./yr)

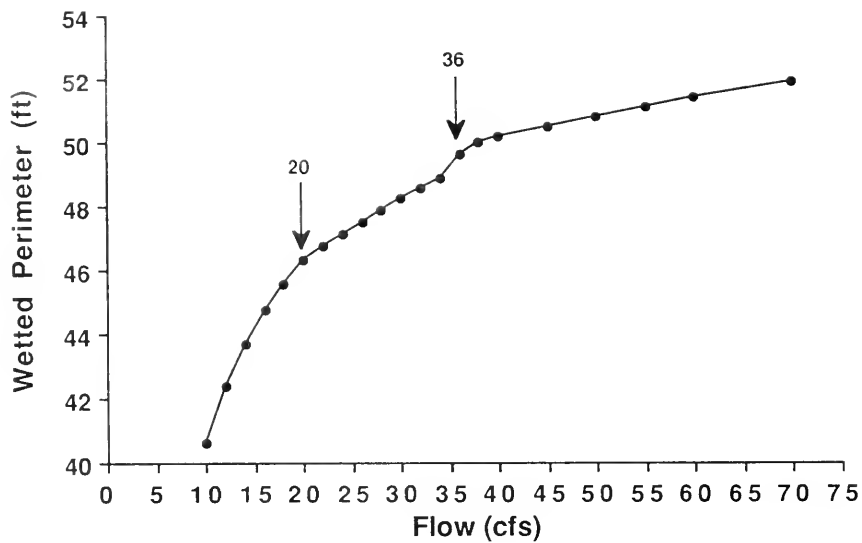


Figure 2-27. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Horse Prairie Creek.

STREAM NAME: Beaverhead River

DESCRIPTION OF BASIN:

The Beaverhead River originates at the outlet of Clark Canyon Reservoir, an irrigation storage facility constructed by the Bureau of Reclamation in 1964, and flows 79.5 miles before joining the Big Hole River to form the Jefferson River. Directly below Clark Canyon Dam the river flows through a canyon for 16 miles before entering the broad, open Beaverhead Valley. At Point of Rocks the river passes through a narrow constriction, then continues for about 20 miles through a wide, gently sloping valley to its confluence with the Big Hole River.

The river drains an area of about 5,000 square miles. A large portion of the drainage consists of rugged mountains ranging from 9,000 to 11,000 ft in elevation. The river elevation at the dam outlet is 5,450 ft and at the mouth is 4,600 ft. Major tributaries entering the river in downstream progression are Grasshopper, Rattlesnake and Blacktail Deer Creeks and the Ruby River.

Dillon, with a population of 5,000, is the largest community in the drainage. Butte, one of the largest cities in southwest Montana with a population of 24,000, is about 70 miles from the Beaverhead River at the nearest point of contact. Livestock production is the most important industry in the drainage and hay the most important crop. Much of the crop and pasture lands within the valley have been developed for irrigation.

Throughout much of its length, the river is confined to a single channel. Mean channel widths range from about 83 ft near the dam to about 93 ft near the mouth. The gradient is gentle, averaging 12 ft per mile. Willow is the dominant bank vegetation. In the upper river, the streambed consists primarily of rubble, gravel and sand. In addition to the above, silt is a common component of the streambed in the lower river. Fish cover primarily consists of submerged and overhanging bank vegetation, undercuts, and long, deep pools.

Clark Canyon Reservoir and irrigation diversions affect the flow pattern in the river. Prior to the construction of the reservoir, much of the lower river was severely dewatered during the summer irrigation season. In general, the reservoir has provided higher flows in the lower river during the pre-impoundment low flow months of May, July, August and September. However, much of the lower 64 miles still suffer from dewatering. In recent years, sections of the lower river have been totally dry. Massive withdrawals of irrigation water have virtually eliminated high water flows in the lower river.

The Beaverhead River primarily flows through private lands. Access to the river is readily obtained through some private lands, publicly owned access sites, and at bridge crossings. Floating is popular during the fishing and waterfowl seasons.

Fishing is the major recreational activity on the Beaverhead River. Between May, 1983 and April, 1984, fishing pressure was estimated at 20,448 angler-days (MDFWP, 1984). Of the 9 major rivers within the upper Missouri

drainage of southwest Montana, the Beaverhead ranks fifth in total fishing pressure.

STREAM NAME: Beaverhead River

STREAM REACH: #1. From Clark Canyon Dam to the East Bench Diversion Dam at Barretts - 16.0 miles

LOCATION: Sec. 32, T9S, R10W to Sec. 17, T8S, R9W

DESCRIPTION OF STREAM REACH:

Reach #1 of the Beaverhead River extends for 16 miles from Clark Canyon Dam to the East Bench Diversion Dam at Barretts. The upper 12.5 miles of Reach #1 between Clark Canyon Dam and the mouth of Grasshopper Creek are classified "Blue Ribbon" by the MDFWP in recognition of their high recreational, fishery and aesthetic values.

The upper portion of Reach #1 is characterized by an abundance of submerged and overhanging willows and undercut banks, which provide excellent instream cover for trout. This reach has an average channel width of about 83 feet and the streambed consists of cobble and gravel. The flow is confined to one or two channels consisting primarily of riffle-pool areas.

Fishing is the major recreational activity on Reach #1. Floating is a popular means of fishing the section due to the dense willow cover and steep undercuts that hinder fisherman access. Numerous outfitters also float the section, providing single-day fishing trips for their clients.

Public access to Reach #1 is provided at a site operated by the Bureau of Reclamation below Clark Canyon Dam, at the 646-acre Pipe Organ fishing access site operated by the MDFWP, and a campground at Barretts operated by the Bureau of Reclamation. All sites receive substantial public use. During the summer of 1980, an estimated 3,264 people, mainly fishermen, visited the Pipe Organ access. Bridge sites provide the remainder of the public access.

Flow in Reach #1 is completely regulated at Clark Canyon Dam. From October through March, Clark Canyon Reservoir stores water for the upcoming irrigation season. Releases into the river are reduced during this period. Irrigation releases occur from April through September. The diversion of irrigation water begins at the East Bench Diversion Dam 16.0 miles below the dam. The major impact of the reservoir on the flow regime of the upper river was to extend the high water period an additional four months from April through September. This extension occurs at the expense of October through March flows.

The mean annual flow at the USGS gage located 14.7 river miles below Clark Canyon Dam and 2.2 miles below the mouth of Grasshopper Creek was 510 cfs for the 1964-79 post-regulation period. Mean monthly flow ranged from 294 cfs (for January) to 951 cfs (for June).

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish.

FISHERY:

Reach #1 of the Beaverhead River, particularly the "Blue Ribbon" portion, is one of Montana's premier trophy trout fisheries. The relatively

large number of four pound and larger brown and rainbow trout that inhabit this section provide anglers with exceptional sport fishing opportunities. Fishermen have caught trout in excess of 14 pounds, while trout as large as 13½ pounds have been captured by personnel of the MDFWP during their annual electrofishing surveys. In addition to brown and rainbow trout, other fish species present include mountain whitefish, burbot, white sucker, longnose sucker, mottled sculpin, longnose dace and carp.

Reach #1 also supports above average numbers of smaller trout. A 1983 population estimate made by the MDFWP using an electrofishing technique showed that a mile of the "Blue Ribbon" section supported approximately 790 adult rainbow trout, weighing 1,309 pounds, and 1,315 adult brown trout, weighing 2,060 pounds. This is one of the highest standing crops for the rivers of Montana. At present, adult rainbow trout average 1.7 pounds each, while brown trout average 1.6 pounds. This is an exceptional average size for a river trout fishery.

The exceptional trophy trout fishery of the upper river developed after Clark Canyon Dam was constructed in 1964 and is attributable, in part, to reservoir water releases which provide favorable conditions for the growth, survival and propagation of trout and the production of trout food organisms.

WILDLIFE:

The bottomland along Reach #1 supports huntable populations of mule deer, white-tailed deer, ruffed grouse and Hungarian partridge. Elk, moose, and black bear are hunted in the surrounding mountains. Furbearers along the river include beaver, muskrat, mink, otter, red fox, bobcat and coyote. Bald eagles commonly winter along the river.

Waterfowl use Reach #1 during spring and fall migrations. Nesting waterfowl include blue-winged teal, mallard, and common merganser. Golden-eyes and mergansers commonly winter on the river.

WETTED PERIMETER:

The wetted perimeter inflection point method was applied to a riffle area of the Beaverhead River (T9S, R10W, Sec. 28) located 1.9 river miles downstream from Clark Canyon Dam. The WETP program was calibrated to field data collected at flows of 255, 289 and 343 cfs. The upper inflection point on the relationship between wetted perimeter and flow for the single riffle cross-section occurred at a flow of about 200 cfs (Figure 2-28).

The wetted perimeter inflection point method was applied in an earlier study to a series of eight riffle cross-sections at a similar location on the upper river. The wetted perimeter-flow relationship for the composite of eight cross-sections (Figure 2-29) was derived using the Water Surface Profile computer program developed by the Bureau of Reclamation. The upper inflection point also occurred at a flow of approximately 200 cfs. This earlier work is discussed by Nelson (1977).

In 1956, prior to the construction of Clark Canyon Reservoir, the U.S. Fish and Wildlife Service prepared a report assessing the effects of the proposed water development project on the fish and wildlife resources (USFWS,

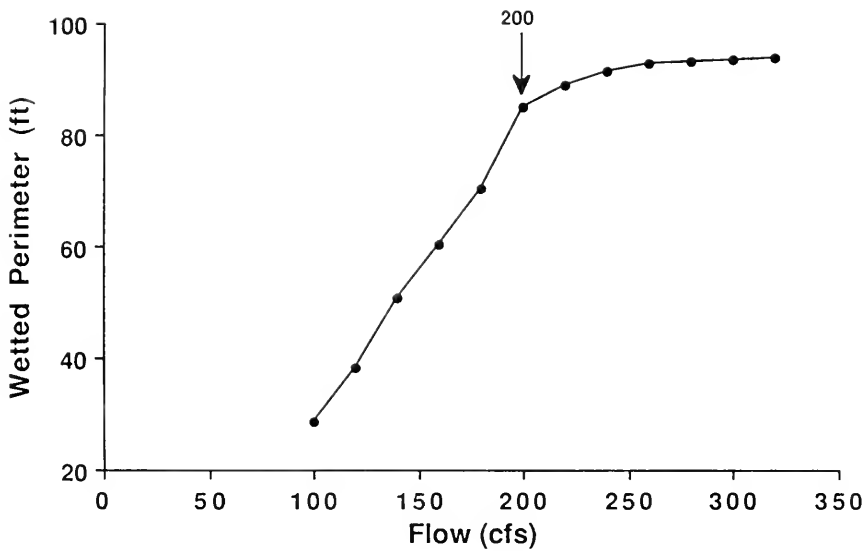


Figure 2-28. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #1 of the Beaverhead River.

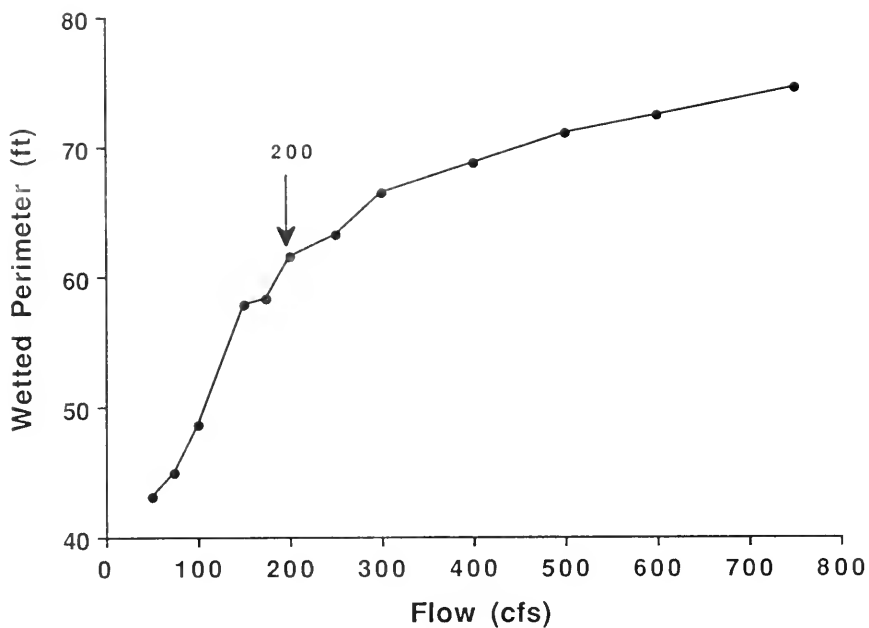


Figure 2-29. The relationship between wetted perimeter and flow for a composite of eight riffle cross-sections in Reach #1 of the Beaverhead River.

1956). The report recommended that the flows of the Beaverhead River between Clark Canyon Dam and the East Bench Diversion Dam be maintained at not less than 250 cfs during the non-irrigation or low flow season. This recommendation was intended to maintain good water quality and at the same time prevent the loss or impairment of trout food production, protective cover and spawning areas. A detailed analysis of the historic flows of the upper Beaverhead for the 1926 through 1951 period of record was used as the basis for deriving the recommendation.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the river and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 200 cfs (144,793 A.F./yr)

STREAM NAME: Beaverhead River

STREAM REACH: #2. From the East Bench Diversion Dam at Barretts to the mouth - 63.5 miles

LOCATION: Sec. 17, T8S, R9W to Sec. 21, T3S, R6W

DESCRIPTION OF STREAM REACH:

The Beaverhead River between the diversion dam at Barretts and its mouth meanders for 63.5 miles through valley agricultural lands developed primarily for irrigated hay production. Major tributaries to this reach are the Ruby River, which enters the Beaverhead River at mile 5.2, and Blacktail Deer Creek.

In addition to stream dewatering, another major concern in Reach #2 is the sedimentation of the bottom substrate. Sediment transport in the river is hindered by the diversion of reservoir releases for irrigation. The removal of large amounts of water reduces water velocity to a point where sediments can no longer remain suspended and, therefore, are deposited in the lower river. Bottom sediments drastically reduce the survival of trout eggs, reduce the numbers and kinds of trout food organisms, and fill in trout habitat. An annual high water period, which has essentially been eliminated by massive irrigation withdrawals, is needed to flush bottom sediments and maintain channel morphology. Blacktail Deer Creek and irrigation return flows from the East Bench irrigation project are major sources of sediment in this reach.

The water in Reach #2 is comparatively cold except in areas subject to extreme dewatering. Temperatures as high as 76.5°F have been recorded in dewatered sections. Temperatures above 70°F are generally considered undesirable for trout.

In addition to sedimentation, dewatering and elevated summer water temperatures, other environmental problems occur in Reach #2. Mercury pollution has been documented in the vicinity of Dillon. Some fish in this area contain mercury greatly in excess of FDA standards. Possible sources of mercury are natural ground water discharges, seed-potato treatment, the leaching of old mill tailings, and industrial activity. Water quality is also threatened by the increasing homesite development occurring along the river and discharges from the outdated sewage treatment facility at Dillon.

Man's increasing activity in the river bottom is also a concern. The removal of bank vegetation through pasture and homesite development and overgrazing is increasing rates of soil erosion and decreasing the amount of trout cover. Much of the trout cover in Reach #2 is provided by overhanging and submerged bank vegetation. Removal of this cover reduces the capacity of the river to support trout.

The USGS has operated a gage at mile 26 of the Beaverhead River since 1935. The mean annual flow for a 44-year period of record was 413 cfs. Mean monthly flows ranged from 216 cfs (for August) to 575 cfs (for November). Regulation at Clark Canyon Reservoir and massive irrigation withdrawals have markedly altered the natural flow pattern of the lower river.

A USGS gage at mile 40 of Reach #2 was operated between 1950 and 1983. The mean annual flow at this site was 380 cfs for an 18-year period of record. Mean monthly flows ranged from 227 cfs (for July) to 515 cfs (for November).

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, burbot.

FISHERY:

Brown trout comprise over 92% of the trout numbers in Reach #2 of the Beaverhead River. Other game fish frequently encountered are rainbow trout, mountain whitefish and burbot. Brook trout and arctic grayling are rare inhabitants of the reach. Resident nongame fish include mottled sculpin, white sucker, longnose sucker, mountain sucker, longnose dace and carp. Carp are common in the lower 20 miles of Reach #2 and uncommon elsewhere.

Trout populations rapidly decline between the upper Beaverhead River below the dam (Reach #1) and the lower river in Reach #2. In a series of nine study sections in spring 1976, standing crop estimates of adult trout per 1,000 ft ranged from 46 pounds in the lower river at about mile 20 to 794 pounds in the upper river near the dam (about mile 77) (Nelson, 1977). Estimated numbers of adult trout per 1,000 ft ranged from 50 to 486. Nelson (1977) concluded that other factors, notably in-channel sedimentation, the removal of streambank vegetation and water quality problems, were operating in conjunction with flow reductions to limit trout populations in the lower river.

In 1988, population work in Reach #2 at Dillon (about river mile 55) showed an estimated 325 age II and older brown trout per 1,000 ft of river. Near the river's mouth downstream from Dillon, brown trout numbers declined to about 128 age II and older per 1,000 ft in 1988. The progressive decline in trout numbers that was observed in 1976 continues today.

WILDLIFE:

The bottomland along Reach #2 supports huntable populations of mule deer, white-tailed deer, ring-necked pheasant and Hungarian partridge. Elk, moose and black bear are hunted in the surrounding mountains. Furbearers along the river include beaver, muskrat, mink, otter, red fox and coyote. Bald eagles commonly winter along the reach.

Waterfowl use the river during spring and fall migrations. Use of Reach #2 by nesting Canada geese is limited. Other nesting waterfowl include blue-winged teal, mallard and common merganser. Goldeneyes and mergansers commonly winter on the river.

WETTED PERIMETER:

Cross-sectional data for use in the wetted perimeter inflection point method were collected for Reach #2 in a river section at about mile 26. The wetted perimeter-flow relationship for the composite of seven riffle cross-sections (Figure 2-30) was derived using the Water Surface Profile Computer Program developed by the Bureau of Reclamation. An upper inflection point occurs at a flow of about 200 cfs.

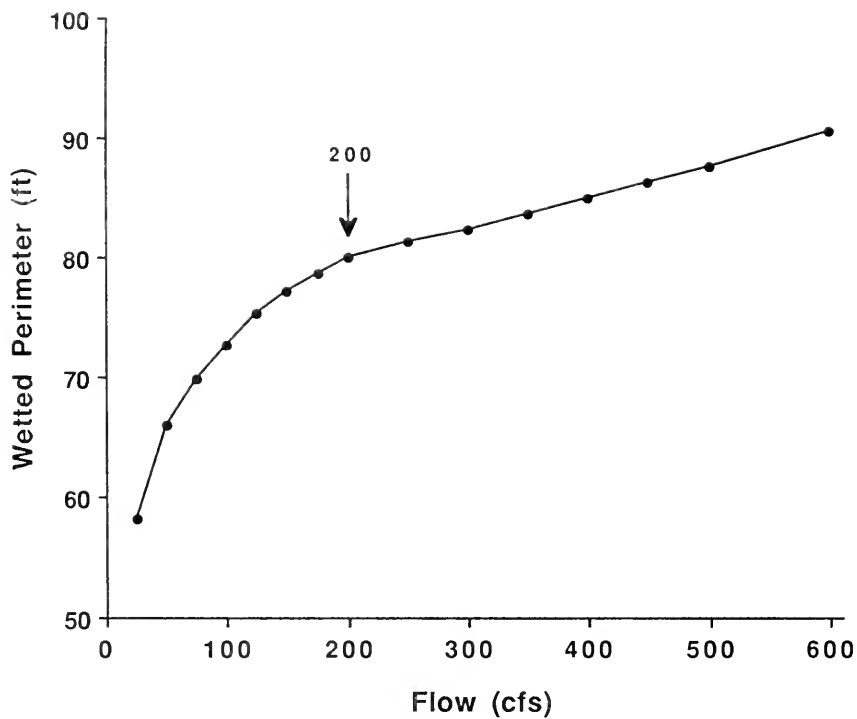


Figure 2-30. The relationship between wetted perimeter and flow for a composite of seven riffle cross-sections in Reach #2 of the Beaverhead River.

In 1956, prior to the construction of Clark Canyon Reservoir, the U.S. Fish and Wildlife Service prepared a report assessing the effects of the proposed water development on the fish and wildlife resources (USFWS, 1956). The report stated that a flow of 200 cfs was needed during the irrigation season to protect fish and wildlife in the section of Reach #2 between Barretts Diversion Dam and the mouth of the Ruby River. A detailed analysis of the historic flows for the 1926 through 1951 period of record was used as a basis for deriving the minimum flow recommendation.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 200 cfs (144,793 A.F./yr)

Given greater flows, particularly during the summer irrigation season, much of Reach #2 is capable of supporting greater trout densities. For this reason, the upper inflection point flow (200 cfs) is requested. A 200 cfs recommendation provides a goal to strive for should the means become available in the future to improve minimum flows in Reach #2 through such mechanisms as the conversion of purchased irrigation rights to instream uses.

STREAM NAME: West Fork of Dyce Creek

STREAM REACH: From the headwaters to the mouth - 4.4 miles

LOCATION: Sec. 11, T6S, R12W to Sec. 26, T6S, R12W

DESCRIPTION OF STREAM REACH:

The West Fork of Dyce Creek originates on the south slope of the Pioneer Mountains at an elevation of 7,920 ft. The stream flows in a southerly direction for 4.4 miles to its junction with the East Fork to form Dyce Creek, a tributary to Grasshopper Creek. The 3.7 square mile drainage is characterized by timbered slopes at high elevations and patches of timber and sagebrush steppes in the lower elevations. The stream is bordered by a narrow riparian zone of willow, alder, aspen, grasses and sedges. Two ponds, created by past mining activity, are located on the stream. The average gradient of the 3 ft wide channel is 58 ft/1,000 ft. Ownership of the drainage is shared by the BLM (70%) and the USFS (30%).

Lands within the West Fork drainage are used for cattle grazing, mining, timber harvesting and recreation in the form of hunting and fishing. Access is provided by a dirt road which parallels the stream.

The BLM owned portion of the drainage is included in a single grazing allotment which is utilized on a rest-rotation basis. The allotment has been surveyed and found to be in good condition in terms of erosion and vegetation and is currently improving (BLM, 1980). A timber sale is currently in effect on the USFS portion of the upper drainage. Stream channel stability and riparian zone status are both rated good.

The West Fork drainage has a history of mining activity. Placer mining for gold occurred in the early 1900's and a tungsten mine and mill were located in the upper drainage. Two ongoing placer operations are located on the stream at the present time.

GAME FISH PRESENT: Rainbow x cutthroat hybrid trout, brook trout.

FISHERY:

An 850 ft section of the West Fork of Dyce Creek (T6S, R12W, Sec. 26BB) was electrofished on July 6 and 14, 1982. Forty-one rainbow x cutthroat hybrids, ranging from 2.4-8.6 inches, and 16 brook trout from 1.0-8.2 inches were captured. Estimates of trout standing crops were not calculated due to the heavy riparian canopy that limited electrofishing efficiency in the section.

Five hundred, 400 and 700 ft sections of upper, middle and lower West Fork of Dyce Creek, respectively, were electrofished on November 13, 1981. Rainbow x cutthroat hybrid numbers ranged between 10 captured in the upper section to 43 captured in the middle section. The fish ranged from 1.7-9.5 inches. Brook trout numbers ranged between 0 captured in the upper section to 22 captured in the middle section. The brook trout ranged from 3.1-7.6 inches. The great majority of the trout captured in the middle section came from a single large pool that had resulted from mining activity.

WILDLIFE:

The West Fork Dyce Creek drainage supports mule deer, elk and moose year-round and antelope and sage grouse from spring through fall. Important winter range for deer and elk is found within the drainage. Other inhabitants include bobcat and black bear.

WETTED PERIMETER:

Cross-sectional data for the West Fork of Dyce Creek were collected in a 31 ft riffle sequence at about stream mile 2.0 (T6S, R12W, Sec. 22AA). Approximately 55% of the drainage area was located above this site. Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 0.8, 1.2 and 2.0 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-31. Inflection points were not discernible on the plot.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.7 cfs (507 A.F./yr)

The wetted perimeter inflection point method failed to provide a flow recommendation for the West Fork of Dyce Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 43% of the average annual flow is being requested for those Beaverhead-Red Rock River tributaries having high fishery values. An average annual flow of 1.7 cfs was estimated by the USGS for the West Fork. An instream flow of 0.7 cfs is, therefore, requested.

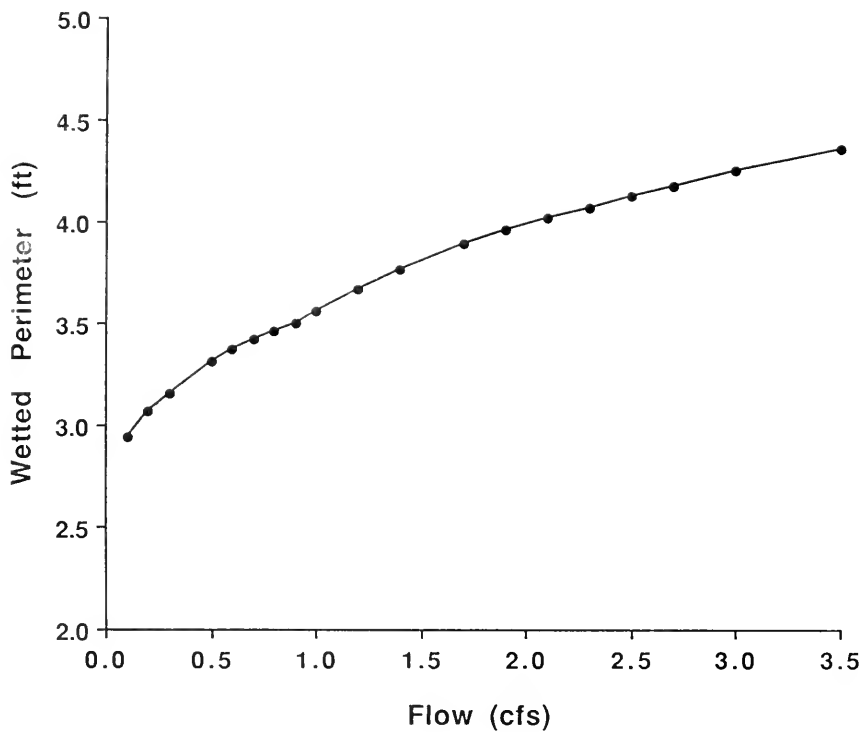


Figure 2-31. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in the West Fork of Dyce Creek.

STREAM NAME: East Fork of Dyce Creek

STREAM REACH: From the headwaters to the mouth - 4.7 miles

LOCATION: Sec. 1, T6S, R12W to Sec. 26, T6S, R12W

DESCRIPTION OF STREAM REACH:

The East Fork of Dyce Creek originates on the south slope of the Pioneer Mountains at an elevation of approximately 8,560 ft. The stream flows in a southerly direction for 4.7 miles to its juncture with the West Fork to form Dyce Creek, a tributary to Grasshopper Creek. The only named tributary of the East Fork is Dry Gulch. The 5.8 square mile drainage is characterized by coniferous timber on the east facing slopes and sagebrush-grassland communities on the west faces. Ownership of the drainage is shared by the BLM (38%), USFS (38%) and private landowners (24%). The stream channel is bordered by a narrow riparian zone of willow, alder, aspen, grasses and sedges. The average gradient of the 3 ft wide channel is 83.7 ft/1,000 ft.

Lands within the East Fork of Dyce Creek drainage are used for cattle grazing, timber harvesting, mining and outdoor recreation in the form of hunting and fishing. Access is provided by a dirt road which parallels the stream.

The BLM portion of the drainage is included in a single grazing allotment which is maintained on a rest-rotation basis. The allotment has been surveyed and found to be in good condition in terms of soil erosion and vegetation and is currently in an improving trend (BLM, 1980). A timber sale is currently in progress on the USFS portion of the upper drainage.

The East Fork of Dyce Creek has had a history of mining activity within the drainage. Maximum gold production occurred in 1908 (Lyden, 1948). A gold mining operation has been proposed for the site of the old Nick Preen mine.

GAME FISH PRESENT: Rainbow x cutthroat hybrid trout, brook trout.

FISHERY:

A 1,000 ft section of the East Fork of Dyce Creek was electrofished on July 6 and 14, 1982. Forty-nine rainbow x cutthroat hybrid trout, ranging from 2.3-9.7 inches, and 26 brook trout from 1.9-8.6 inches were captured. No other species were present.

Standing crops of rainbow x cutthroat hybrid and brook trout were estimated using a mark-recapture method (Table 2-27). The section supported 75 trout, weighing 10 pounds. Rainbow x cutthroat hybrid trout accounted for 66% of the numbers and 70% of the biomass. Trout 6 inches and longer accounted for 54% of the total population. Brook trout condition (length to weight ratio) was excellent and well above average when compared with streams in the Big Hole River drainage. The fish habitat of Dyce Creek was evaluated as being in very good condition in a BLM district survey.

Table 2-27. Estimated standing crops of rainbow x cutthroat hybrid and brook trout in a 1,000 ft section of East Fork of Dyce Creek (T6S, R12W, Sec. 26DD) on July 6, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow x cutthroat hybrid trout	4.5 - 6.9	26	
	7.0 - 9.7	<u>24</u>	
		50(±8)	7(±1)
Brook trout	5.0 - 6.4	15	
	6.5 - 8.6	<u>10</u>	
		25(±5)	3(±1)
Total trout		75(±9)	10(±1)

WILDLIFE:

The East Fork of Dyce Creek drainage supports mule deer, moose and elk year-round and seasonal populations of antelope and sage grouse from spring through fall. Important winter range for deer and elk is found within the drainage. Other resident wildlife include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data for the East Fork of Dyce Creek were collected in a 74 ft riffle section at stream mile 0.2 (T6S, R12W, Sec. 26DD). Approximately 99% of the total drainage area is located above this site. Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 1.3, 2.1 and 4.4 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-32. Lower and upper inflection points occur at 0.4 and 1.4 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.4 cfs (1,014 A.F./yr)

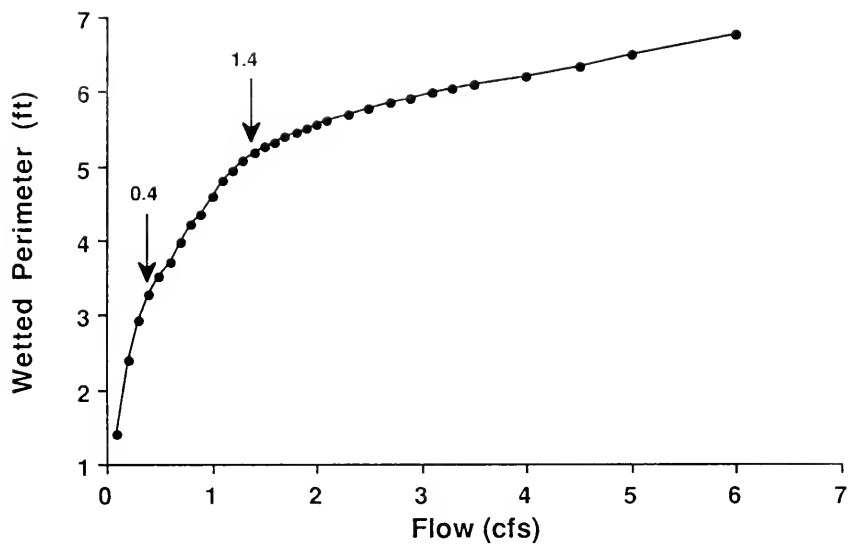


Figure 2-32. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in the East Fork of Dyce Creek.

STREAM NAME: Reservoir Creek

STREAM REACH: From the headwaters to the mouth - 12.1 miles

LOCATION: Sec. 7, T8S, R13W to Sec. 1, T8S, R12W

DESCRIPTION OF STREAM REACH:

Reservoir Creek originates at the Big Hole Divide and flows due east for 12.1 miles before entering Grasshopper Creek, a tributary to the Beaverhead River. It drains an area of approximately 14 square miles. The upper 3 miles of stream pass through the Beaverhead National Forest, while the lower 9 miles flow through state, private and BLM controlled parcels.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 300 ft section of Reservoir Creek located immediately above the Forest Service boundary at stream mile 9 was electrofished in 1986. This section is located in a mixed aspen, conifer and grass vegetative type. Channel gradient is low (near two percent) and the streambed is predominated by gravel and sand. The primary land use along this stretch is cattle grazing.

The only game fish captured in Reservoir Creek was the westslope cutthroat trout. Analyses performed at the University of Montana Genetics Laboratory found this population to be genetically pure.

A population estimate conducted in the above section in September, 1986 found 510 westslope cutthroat trout 3.0 inches and longer per mile, with 300 of these 6.0 inches and longer. The cutthroat captured averaged 4.3 inches in length.

WILDLIFE:

The lower portion of the Reservoir Creek drainage supports antelope and sage grouse year-round. Elk, moose and black bear inhabit the upper drainage year-round while mule deer are present from spring through fall. Other resident wildlife of interest include bobcat and mountain grouse.

Geese and ducks are found along the lower portion of the creek. Birds of prey, particularly rough-legged hawks and bald and golden eagles, are often seen in the lower drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.5 cfs (1,086 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Reservoir Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 43% of the average annual flow is being requested for those Beaverhead-Red Rock River tributaries having high fishery values. An average annual flow of 3.6 cfs was estimated by the USGS for Reservoir Creek. An instream flow of 1.5 cfs is, therefore, requested.

STREAM NAME: Grasshopper Creek

STREAM REACH: From the confluence of Blue Creek to the mouth - 45.2 miles

LOCATION: Sec. 32, T4S, R12W to Sec. 25, T8S, R10W

DESCRIPTION OF STREAM REACH:

Grasshopper Creek originates in the Rainy and Saddleback Mountains of the Pioneer Range and Big Hole Divide of southwest Montana. It flows in a southeasterly direction for approximately 50 miles before entering the Beaverhead River, 14 miles southwest of Dillon, Montana. Between its headwaters and mouth, the stream changes from a narrow willow-lined channel draining steep forested slopes to a meandering small river draining sagebrush/grassland benches. The average gradient of the 36 ft wide channel is approximately 6 ft/1,000 ft. Control of the 350 square mile drainage is shared by the USFS (32%), BLM (31%), private individuals (30%) and the State of Montana (7%). Of the 50+ tributaries to Grasshopper Creek, major ones include Dyce, Taylor, Buffalo, Divide, Cold Springs, Blue and Hot Springs Creeks.

Lands within the Grasshopper Creek drainage are currently used for livestock grazing, hay production and recreation in the form of fishing, hunting, skiing, snowmobiling, hiking and sightseeing. Access is provided by a county road which parallels the stream for all but 4 miles of its length. A commercial hot springs resort and a downhill ski area are located within the drainage.

Historically, the major activity within the Grasshopper Creek drainage was placer mining. Gold was first discovered in 1862. With the flurry of mining activity came 5,000 prospectors and the founding of the town of Bannack, Montana's first state capital. By 1905, gold valued at \$2,500,000 had been recovered. By 1930, the gold was depleted and the people moved on. Today, the town of Bannack is a state park.

The scars of past mining activity remain within the drainage. Major impacts on the stream were the loss of riparian habitat, toxic metals pollution and the destruction of instream habitat by dredging. Approximately 17 miles of stream have been damaged by mining.

Toxic metals began leaching into Grasshopper Creek when the stream began eroding old tailing piles on the banks. No trace of the metals could be detected in the waters of Grasshopper Creek. However, extremely high concentrations of mercury, arsenic, zinc and other metals were found in the stream sediments. In 1970, the MDFWP documented the presence of elevated mercury levels in the flesh of some trout from Grasshopper Creek and the Beaverhead River below its confluence. After further investigation, it was hypothesized that mercury was assimilated into the food chain and then into the fish through the ingestion of aquatic organisms. All orders of macro-invertebrates below the tailings area on Grasshopper Creek are depressed, with Plecoptera and Ephemeroptera the most affected orders.

In 1976, through a cooperative effort between the SCS and the Montana Department of Fish, Wildlife and Parks, Grasshopper Creek was diverted from

the tailings area and riprapped. This project was initiated to reduce the level of metals pollution in Grasshopper Creek.

The water quality of Grasshopper Creek above the tailings area (near Polaris, Montana) was sampled sporadically during 1973-76 (USFS, unpublished data). The overall quality is excellent.

A gage station at stream mile 1.4 of Grasshopper Creek was intermittently operated by the USGS from 1921-1961. The mean annual flow for a 23-year period of record was 51.6 cfs. Mean monthly flows ranged from 19 cfs (for September) to 137 cfs (for June). Base winter flow was 24 cfs. There are diversions for the irrigation of about 12,500 acres above this station. Consequently, the lower creek is severely dewatered during most irrigation seasons.

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, brook trout, rainbow x cutthroat hybrid trout.

FISHERY:

An 8,072 ft section of Grasshopper Creek was electrofished on July 29 and August 11, 1980. The section was located approximately 9 miles below Bannack, the source of the toxic metals found in the stream sediments. Fifty-seven brown trout from 6.5-17.4 inches, 25 mountain whitefish from 4.1-14.4 inches, and 9 rainbow trout from 6.9-15.0 inches were captured. Other species present were longnose sucker, longnose dace and mottled sculpin.

The standing crop of game fish in the section was estimated using a mark-recapture method (Table 2-28). This section supported about 16 game fish, weighing a total of 8 pounds, per 1,000 ft of stream. Brown trout, the predominant species, comprised about 69% and 75% of the total game fish numbers and biomass, respectively. Brown trout condition (length to weight ratio) was below average when compared to other streams and rivers in the Beaverhead drainage. The population of rainbow trout was too sparse to estimate using the mark-recapture method.

It is apparent, based on the low numbers of trout and their poor condition, that past mining activity within the drainage is still impacting the fishery of Grasshopper Creek.

Table 2-28. Estimated standing crop of game fish in an 8,072 ft section of Grasshopper Creek (T8S, R10W, Sec. 28N½) on July 29, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	6.5 - 9.9	4	
	10.0 - 13.9	5	
	14.0 - 17.4	<u>2</u>	
		11(±2)	6(±1)
Mountain whitefish	4.1 - 14.4	5(±2)	2(±1)
Total game fish		16(+3)	8(±1)

Grasshopper Creek above the town of Bannack is predominantly a brook trout fishery. Wipperman and Needham (1965) made two electrofishing passes through a 300 ft section of the upper creek in 1964. They captured 220 brook trout, of which 19% were longer than 7 inches. Small numbers of rainbow and rainbow x cutthroat hybrid trout were also captured. The upper creek above Bannack supports an excellent small stream fishery.

WILDLIFE:

The Grasshopper Creek drainage supports elk, moose and mule deer year-round, providing important winter range for these species. Antelope are seasonal residents from spring through fall. Other wildlife present include black bear and bobcat.

WETTED PERIMETER:

Cross-sectional data for Grasshopper Creek were collected in an 86 ft section at stream mile 1.5 (T8S, R10W, Sec. 26D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 53.9, 105.4 and 234.6 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-33. A prominent upper inflection point occurs at a flow of about 30 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

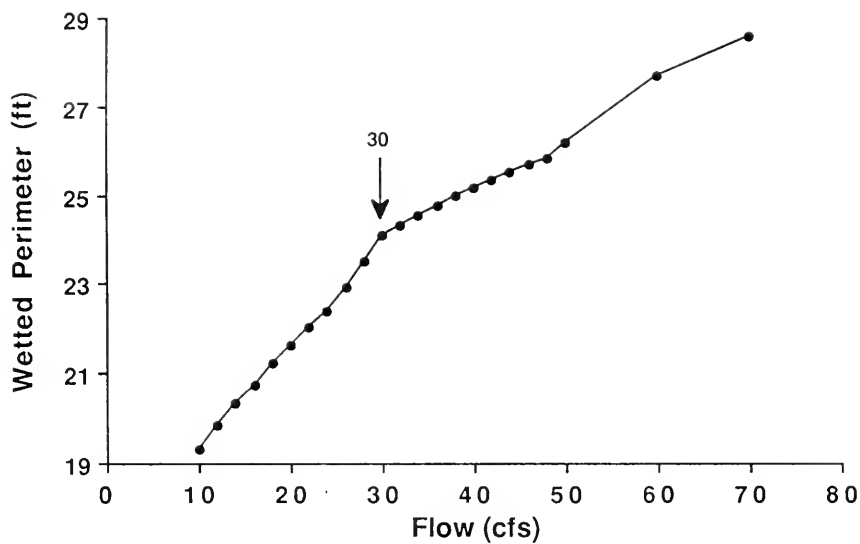


Figure 2-33. The relationship between wetted perimeter and flow for a single riffle cross-section in Grasshopper Creek.

FLOW REQUEST: January 1-December 31 -- 30 cfs (21,719 A.F./yr)

The depressed fishery in the lower 21 miles of Grasshopper Creek below the town of Bannack - the consequence of past mining abuses - does not warrant a flow recommendation at the upper inflection point. However, the fishery could improve substantially, depending on the outcome of present and future mine reclamation projects. For this reason, the high inflection point flow (30 cfs) is being recommended. Should the stream be reclaimed in the future, a 30 cfs reservation would help insure that the flow remaining in Grasshopper Creek is sufficient to accommodate a potentially expanding trout population.

STREAM NAME: Poindexter Slough

STREAM REACH: Springs and Canal in SW, Sec. 3, T8S, R9W to the confluence with the Beaverhead River - 4.2 miles

LOCATION: Sec. 3, T8S, R9W to Sec. 26, T7S, R9W

DESCRIPTION OF STREAM REACH:

Poindexter Slough begins as a small tributary stream at the base of the north slope of the Blacktail Mountains. The stream remains small and relatively unimpressive until well out on the Beaverhead Valley floor where numerous large springs quickly enlarge the flow. Near the origin of these first large springs, flow of Poindexter Slough is also augmented by inflow from the Beaverhead River via a diversion and canal. During the irrigation season, the majority of this diverted river water is subsequently rediverted from the slough into a canal located about two miles downstream. Lands adjacent to the upper mile of the 4 mile stream reach below the springs are privately owned and managed as a recreational property. The majority of the remaining 3 miles are owned by the MDFWP and managed primarily for fishing access and waterfowl habitat.

The 15-40 ft wide stream channel is characterized by a gentle gradient (about 15 ft per mile), numerous meanders and a substrate dominated by fine sediments and gravel. Dense mats of rooted macrophytes cover much of the stream bottom in summer. The riparian zone is dominated by willow, rose, grasses and forbs. Streambank stability and riparian vigor have improved since public acquisition and the elimination of grazing.

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout, mountain whitefish.

FISHERY:

Study sections on Poindexter Slough have been electrofished since 1967 and annually since 1980. The game fish population is dominated by brown trout, which range in density from 325 to 676 per 1,000 ft, depending on the annual recruitment of young. Rainbow trout are also present, with spring densities as high as 288 per 1,000 ft. However, rainbow trout have recently declined under the dominance of the brown trout. Other game fish present include mountain whitefish and an occasional brook trout. Nongame species include mottled sculpin and white and longnose suckers. Population data for 1981, which exemplify the high productivity of Poindexter Slough, are presented in Table 2-29. Of the spring creeks in southwest Montana, Poindexter Slough supports one of the highest standing crops of trout.

Poindexter Slough annually supports in excess of 2,000 angler-days of fishing pressure, according to 1975 and 1982 estimates. The stream provides a high quality angling experience in a spring creek setting that is freely accessible to the general public.

Table 2-29. Estimated standing crop of brown and rainbow trout in a 3,200 ft section of Poindexter Slough (Sec. 35, T7S, R9W) in March, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Numbers	Pounds
Brown trout	3.5 - 6.4	448	
	6.5 - 8.9	42	
	9.0 - 12.9	132	
	13.0 - 15.9	48	
	16.0 - 21.9	6	
		676(±128)	158(±13)
Rainbow trout	3.0 - 7.9	214	
	8.0 - 12.9	37	
	13.0 - 19.4	37	
		288(±69)	82(±14)
Total trout		964(±145)	240(±19)

WILDLIFE:

An abundant white-tailed deer population inhabits the riparian and agricultural lands bordering Poindexter Slough. Important furbearers include mink, muskrat and beaver. The area provides important nesting, resting and winter habitat for an abundant array of waterfowl, as well as a variety of nongame bird species. Waterfowl use is extensive especially after the freeze-up of local ponds and lakes.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the resident trout fishery of Poindexter Slough; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 57.9 cfs (41,918 A.F./yr)

Poindexter Slough is spring-fed and not appreciably influenced by snow-melt. (It should be noted that, during the irrigation season, flow of Poindexter Slough is augmented with water diverted from the Beaverhead River.) Spring creeks receive special consideration in the instream flow program of the MDFWP. Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that all remaining unappropriated waters in

Poindexter Slough remain instream for the maintenance of fish and wildlife habitat.

Flow of Poindexter Slough at its mouth was measured in February, 1988, when the stream was at or near the annual low-flow condition. The measured flow was 57.9 cfs. This measurement was made during a period of extended drought and likely reflects a somewhat below average base winter flow. The base flow, estimated at 57.9 cfs, is, therefore, requested for the fishery.

STREAM NAME: West Fork Blacktail Deer Creek

STREAM REACH: From the confluence of Grays Fork and the South Fork of the West Fork Blacktail Deer Creek to the mouth - 16.9

LOCATION: Sec. 19, T12S, R5W to Sec. 9, T11S, R6W

DESCRIPTION OF STREAM REACH:

The West Fork Blacktail Deer Creek arises in the Snowcrest Range and Clover Divide of southwest Montana at the confluence of Grays Fork and the South Fork of the West Fork. It flows for 16.9 miles before converging with the Middle Fork to form Blacktail Deer Creek, a tributary to the Beaverhead River. The stream meanders in a northerly direction through a floodplain vegetated with grasses, forbs and sparse clumps of willow and birch. Average gradient of the seven ft wide channel is approximately 38 ft per 1,000 ft. Much of the drainage is comprised of sagebrush/grassland plant communities. Only the upper portion is forested. Control of the 50.5 square mile drainage is shared by the State of Montana (32%), USFS (28%), BLM (22%) and private individuals (19%). Major tributaries to the West Fork Blacktail Deer Creek include the South Fork and Grays Fork. Flows are augmented by numerous springs within the drainage.

Lands within the West Fork drainage are used primarily for livestock grazing and recreation in the form of hunting, fishing and hiking. An improved road parallels the entire West Fork, providing access throughout the drainage.

The erosive nature of the soils in the upper West Fork Blacktail drainage coupled with grazing activities have caused considerable erosion, increasing sediment yields to the stream. Several major slumps resulting from road construction along the channel have also contributed to the increased sediment load.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of the West Fork Blacktail Deer Creek was electro-fished on July 21 and August 12, 1980. Eighty-three brook trout, ranging from 4.0-10.4 inches, and 9 rainbow trout from 3.2-11.2 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-30). This 1,000 ft section supported about 84 brook trout 5.0 inches and longer, weighing a total of 15 pounds. The population is only fair for a stream of this size, although the condition of the trout (length to weight ratio) was above average. Only 40% of the fish captured were less than six inches, suggesting poor reproductive success. The increased sediment load may be reducing egg survival as well as decreasing the production of fish food.

Table 2-30. Estimated standing crop of brook trout in a 1,000 ft section of West Fork Blacktail Deer Creek (T12S, R6W, Sec. 35A) on July 21, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	26	
	6.0 - 9.9	57	
	10.0 - 10.4	<u>1</u>	
		84(±9)	15(±1)

WILDLIFE:

The West Fork drainage supports year-round populations of elk, mule deer and moose and, along its lower end, antelope. Beaver, mink and an occasional mountain lion and bobcat are other inhabitants of the drainage. Game birds present are blue grouse and a few sage grouse.

WETTED PERIMETER:

Cross-sectional data for the West Fork Blacktail Deer Creek were collected in a 60 ft riffle-run sequence in T12S, R6W, Sec. 35A. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 8.9, 18.1 and 36.8 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-34. Lower and upper inflection points occur at about 1.0 and 3.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.0 cfs (2,172 A.F./yr)

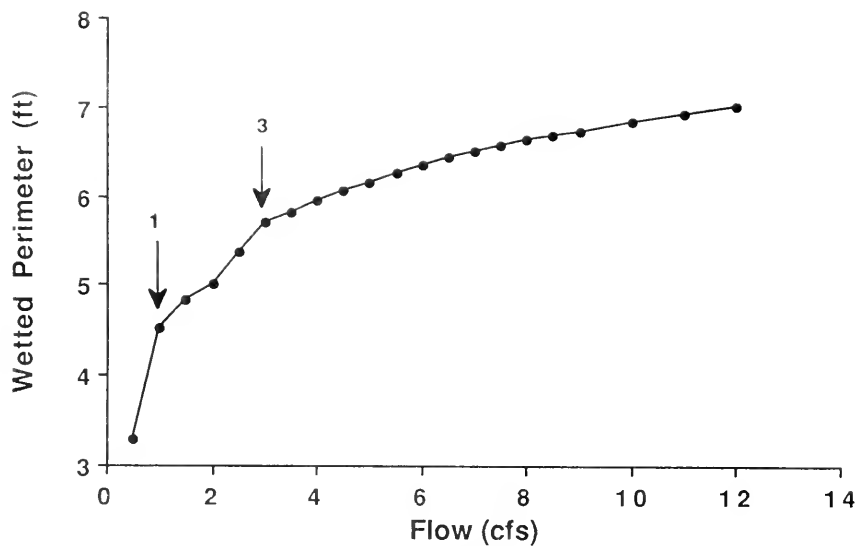


Figure 2-34. The relationship between wetted perimeter and flow for a single riffle cross-section in the West Fork of Blacktail Deer Creek.

STREAM NAME: East Fork Blacktail Deer Creek

STREAM REACH: From the headwaters to the mouth - 20 miles

LOCATION: Sec. 20, T11S, R4W to Sec. 5, T11S, R6W

DESCRIPTION OF STREAM REACH:

The East Fork Blacktail Deer Creek originates in the Snowcrest Range in southwest Montana, approximately 25 miles south of Dillon, Montana. It flows for 20 miles in a northeasterly direction before entering Blacktail Deer Creek, a tributary to the Beaverhead River. Land ownership of the 56 square mile drainage is shared by the USFS (43%), Montana Department of Fish, Wildlife and Parks (36%) and BLM (14%). The East Fork flows in a 15-25 ft wide channel having an average gradient of 19 ft per 1,000 ft. The riparian zone is vegetated with conifers, willow, birch, grasses and sedges. Extensive beaver dam development within the middle reach causes the stream to lose much of its fluvial nature. Major tributaries include Alkali, Indian, Rough, Meadow and Lawrence Creeks. The drainage is characterized by sagebrush/grassland slopes and conifer covered headwater ridges.

Lands within the drainage are primarily used for wildlife winter range, recreational activities in the form of hunting, fishing and camping, and livestock grazing. Access is provided by an unimproved road paralleling the stream for its lower 12 miles and a trail system along the upper 7 miles. In 1974, the MDFWP acquired 18,000 acres within the drainage for the protection of critical elk winter range.

All lands within the East Fork drainage are publicly owned. Only USFS and BLM lands within the upper drainage are currently being grazed by livestock. Streambank stability and riparian zones are in fair to good condition throughout the drainage.

GAME FISH PRESENT: Brook trout, rainbow trout, mountain whitefish, cutthroat trout.

FISHERY:

Fisheries information was collected in 1974 and 1975 on two sections of the East Fork Blacktail Deer Creek (Peterson, 1976). One of the sections was established to measure changes in fish populations over a long period (10-20 years) in a portion of stream that was previously heavily grazed by livestock. Grazing was discontinued in 1974 when the property was purchased by the MDFWP. A relatively undisturbed section located 2.2 miles upstream served as a control.

Game fish present in both sections in descending order of abundance were brook trout, rainbow trout and mountain whitefish. Cutthroat trout were also present in small numbers.. The mottled sculpin was the only non-game species present. The electrofishing survey data for 1975 only are summarized in Table 2-31.

Table 2-31. Summary of electrofishing survey data collected for a 3,650 ft control section (T11S, R5W, Sec. 3) and a 4,860 ft disturbed section (T11S, R5W, Sec. 8) of East Fork Blacktail Deer Creek in August, 1975.

Fish Species	Number Captured		Length Range (inches)	
	<u>Control</u>	<u>Disturbed</u>	<u>Control</u>	<u>Disturbed</u>
Brook trout	599	208	4.0 - 14.9	4.0 - 13.7
Rainbow trout	34	24	6.4 - 16.1	6.9 - 16.1
Mountain whitefish	46	160	9.4 - 18.1	6.6 - 16.4
Mottled sculpin	-	-	-	-

The estimated standing crops of trout in both sections in 1975 are presented in Table 2-32. The brook trout, the predominant trout species, comprised over 88% of the total trout numbers and biomass in both sections. The control (undisturbed) section supported about 164 brook and rainbow trout, weighing 52 pounds, per 1,000 ft of stream. The trout biomass in the control section was two times greater than in the disturbed section. The control was characterized by the presence of a greater number of larger trout.

Table 2-32. Estimated standing crops of trout in a 3,650 ft control section (T11S, R5W, Sec. 3) and a 4,860 ft disturbed section (T11S, R5W, Sec. 8) of East Fork Blacktail Deer Creek in August, 1975. Eighty percent confidence intervals are in parentheses.

Species	Length Range (inches)	<u>Control</u>		<u>Disturbed</u>	
		<u>Per 1,000 ft</u>		<u>Per 1,000 ft</u>	
		Numbers	Pounds	Numbers	Pounds
Brook trout	4.0 - 5.9	43		49	
	6.0 - 9.9	67		35	
	10.0 - 14.9	<u>46</u>		<u>18</u>	
		156(±11)	48(±2)	102(±12)	23(±2)
Rainbow trout	6.4 - 9.9	5		5	
	10.0 - 16.1	<u>3</u>		<u>2</u>	
		8(±1)	4(±1)	7(±3)	3(±1)
Total trout		164(±11)	52(±2)	109(±12)	26(±2)

Standing crops of trout in a 2,650 ft section near the mouth of East Fork Blacktail Deer Creek were estimated in 1970 (Elser and Marcoux, 1972). The brook trout, the predominant trout species, accounted for 88% of the total trout numbers. This section supported an estimated population of 114 brook and rainbow trout, weighing 34 pounds, per 1,000 ft.

WILDLIFE:

Lands within the 18,000 acre Blacktail Wildlife Management Area are extensively used by wintering elk from early fall through spring. Mule deer, white-tailed deer, antelope, moose and mountain goat are year-round residents of the East Fork drainage. Other wildlife present are beaver, mink and an occasional black bear. Sage and blue grouse are the main resident upland game birds. Minor waterfowl production occurs along the East Fork. In addition to providing critical winter range, Blacktail Wildlife Management Area is also noted as an important nesting area for the Ferruginous hawk.

WETTED PERIMETER:

Cross-sectional data for the East Fork Blacktail Deer Creek were collected in an 81 ft riffle-pool sequence near stream mile 14.0 (T11S, R5W, Sec. 34A). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 19.9, 35.6 and 49.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-35. Lower and upper inflection points occur at about 12 and 18 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 18 cfs (13,031 A.F./yr)

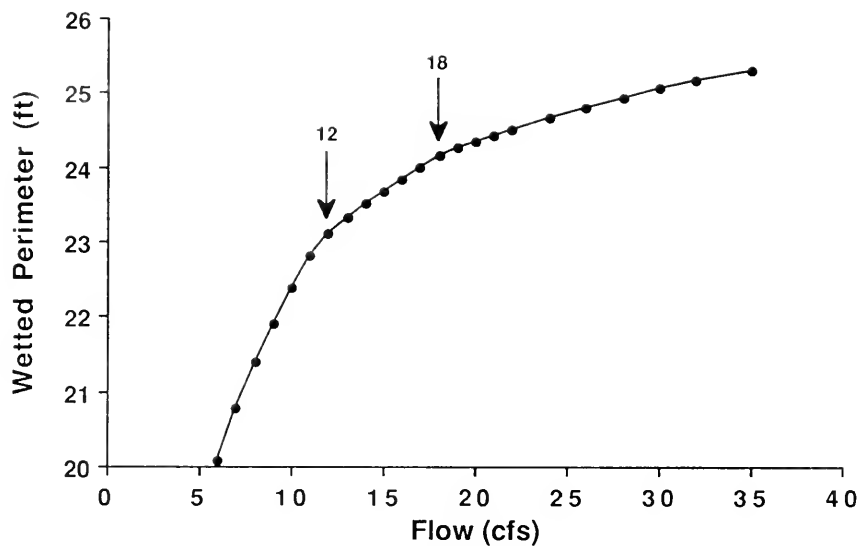


Figure 2-35. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the East Fork of Blacktail Deer Creek.

STREAM NAME: Blacktail Deer Creek

STREAM REACH: From the confluence of the Middle and West Forks to the county road at the boundary of Sec. 20 and 29, T8S, R8W - 32.3 miles

LOCATION: Sec. 9, T11S, R6W to boundary of Sec. 20 and 29, T8S, R8W

DESCRIPTION OF STREAM REACH:

Blacktail Deer Creek originates in the Blacktail and Snowcrest Ranges and Clover Divide in southwest Montana. It is formed at the convergence of its West and Middle Forks and flows in a northwesterly direction for 43.2 miles to the town of Dillon, Montana, where it enters the Beaverhead River. The drainage is characterized by sagebrush/grassland benches and foothills, much of which have been converted to irrigated hay pastures. The steep, rugged Blacktail Mountains, which border the creek on the west, and the uppermost portion of the basin surrounding the three forks are the only timbered areas in the 423 square mile drainage. Ownership of the drainage is shared by private individuals (40%), the BLM (25%), the State of Montana (22%), the USFS (10%) and the MDFWP (3%). Although less than half of the drainage is privately owned, the entire length of Blacktail Deer Creek flows through private property. In addition to the three forks, major tributaries include Moose and Crazy Creeks and numerous springs. The riparian zone is comprised of dense willows, forbs and grasses which give way to cottonwood stands along the lower 12 miles. The average gradient of the 36 ft wide channel is approximately 8.5 ft per 1,000 ft.

Lands within the Blacktail Deer Creek drainage are used primarily for agriculture, wildlife propagation (Blacktail Wildlife Management Area) and recreation in the form of hunting and fishing. Major agricultural activities include cattle grazing and the production of wild hay in the upper drainage and grain and cultivated hay in the lower drainage. Access is provided by a partially paved road which parallels the stream for its entire length.

Due to the extensive use of lower Blacktail Deer Creek for irrigation during the growing season, much of the channel is severely dewatered by late summer. Extremely fragile and easily erodible soils in the upper reaches of the West Fork have contributed a considerable sediment load to the main Blacktail. Overuse of the riparian zone by cattle is evidenced by trampled banks, loss of vegetative cover and widening of the channel on portions of the stream. Channel confinement structures and the clearing of the channel and adjacent fields have nearly destroyed the natural configuration of the stream upstream from where it enters the Beaverhead River. Water quality may be degraded downstream from a feedlot and meat packing plant located on the stream.

In 1973 and again in 1979, major fish kills occurred on lower Blacktail Deer Creek. Canyon Ditch, a major irrigation canal serving the Dillon area, uses the Blacktail channel for approximately 1.2 miles to transport water across the valley. Herbicides applied to the ditch to control aquatic weeds were responsible for the kills.

A USGS gage station was operated at stream mile 18.9 of Blacktail Deer Creek from 1946 through 1966. The mean annual flow for the 18 complete years

of record was 54.0 cfs. Mean monthly flows ranged from 30 cfs (for January) to 127 cfs (for June). Water to irrigate about 4,000 acres is diverted above this site.

GAME FISH PRESENT: Brook trout, rainbow trout, mountain whitefish.

FISHERY:

A 5,280 ft section of Blacktail Deer Creek was electrofished on July 29 and August 11, 1980. One hundred fifty-six brook trout, ranging from 3.0-13.9 inches, and 14 rainbow trout from 6.6-14.7 inches were captured. Other species present were mountain whitefish, mottled sculpin and longnose dace.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-33). This section supported about 69 brook trout 5.0 inches and longer, weighing 24 pounds, per 1,000 ft of stream. Thirty-five percent of the trout were 10.0 inches and longer, with each weighing between 0.5 and 1.3 pounds. Due to the low numbers of rainbow trout captured, a standing crop estimate was not possible.

Table 2-33. Estimated standing crop of brook trout in a 5,280 ft section of Blacktail Deer Creek (T9S, R8W, Sec. 14) on July 29, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	10	
	6.0 - 9.9	35	
	10.0 - 13.9	<u>24</u>	
		69(±17)	24(±6)

WILDLIFE:

Lands adjacent to Blacktail Deer Creek support year-round populations of antelope, moose, mule deer and white-tailed deer. White-tail numbers are rated as excellent. Other resident wildlife include beaver, mink and an occasional black bear and bobcat. A few sage grouse and waterfowl are also present.

WETTED PERIMETER:

Cross-sectional data for Blacktail Deer Creek were collected in a 304 ft section at the abandoned USGS gage station at stream mile 18.9 (T9S, R8W, Sec. 14C). Five cross-sections defining the various habitat types were

established. The WETP program was calibrated to field data collected at flows of 77.0, 112.0 and 194.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-36. Lower and upper inflection points occur at flows of about 32 and 52 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 42 cfs (30,407 A.F./yr)

Due to environmental problems - summer dewatering being the most notable - trout numbers throughout much of Blacktail Deer Creek are less than expected for a stream of its size. A flow midway (42cfs) between the lower and upper inflection points is, therefore, requested.

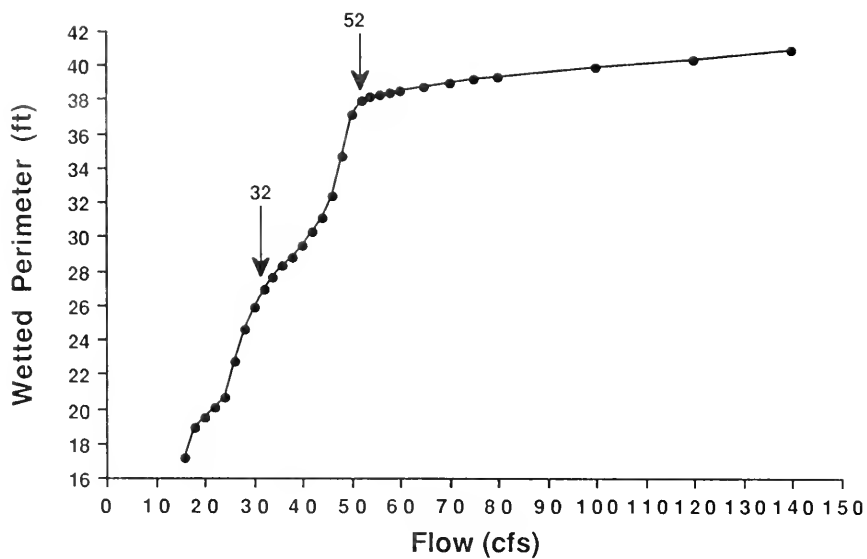


Figure 2-36. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Blacktail Deer Creek.

RUBY RIVER SUB-BASIN

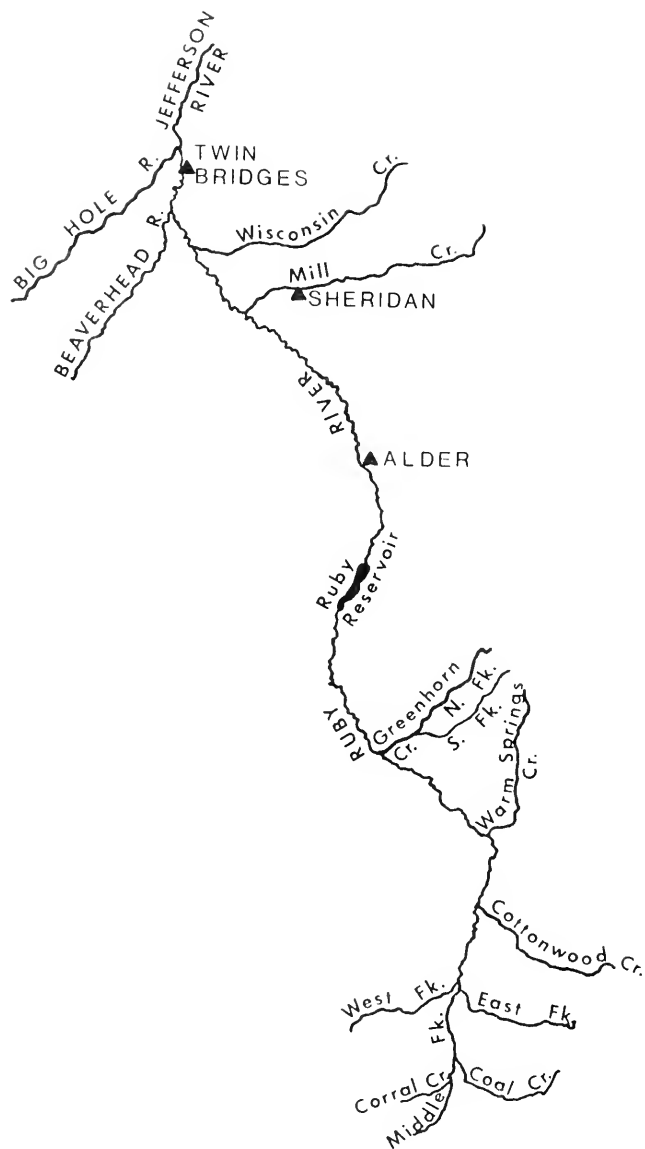


Figure 2-37. Map of the Ruby River Sub-Basin.

STREAM NAME: Ruby River

GENERAL DESCRIPTION OF BASIN:

The Ruby River arises from tributaries (its East, West and Middle Forks) located in the Gravelly and Snowcrest mountains of southwest Montana and flows in a northwesterly direction for 41 miles through a narrow valley to Ruby Reservoir. Ruby Reservoir, built in 1939, is used for the storage of irrigation water. Below Ruby Dam the river meanders about 48 miles through an agricultural valley to its confluence with the Beaverhead River. The river drains an area of about 935 square miles.

Fishing is the major recreational activity within the river corridor. Some recreational floating occurs on the lower river. The Ruby River accounted for an estimated 6,927 man-days of angling from May, 1983 to April, 1984.

STREAM NAME: Ruby River

STREAM REACH: #1. From the convergence of the East, Middle and West Forks to Ruby Reservoir - 40.7 miles

LOCATION: Sec. 5, T11S, R3W to Sec. 30, T7S, R4W

DESCRIPTION OF STREAM REACH:

Reach #1 of the Ruby River passes through the upper Ruby Valley. The valley has a broad floodplain bounded on the west by the steep, mountainous Snowcrest Range and on the east by the more gentle, rolling Gravelly Range. Elevations in the upper valley range from 5,900 to 10,500 ft. Lands within the 538 square mile upper drainage are primarily controlled by the USFS and BLM. Average gradient of the 50 ft wide river channel is fairly constant at 7 ft/1,000 ft. Gravel roads, which parallel the river and many of its tributaries, allow excellent access into the drainage.

The upper drainage is comprised of 61% grassland, 12% forest, 13% subalpine grassland, 12% noncommercial timber and 2% wet meadow and willow bottom (Page, 1978). Riparian species are primarily willow, alder, birch and grasses and sedges.

Historically, the grasslands of the upper Ruby basin were used by American bison, bighorn sheep, pronghorn antelope and grizzly bear. Beginning in the late 1800's these grasslands were severely overgrazed by domestic sheep and cattle (Page, 1978). In 1902, with the establishment of National Forests, the high country was allotted for sheep pasture and the low ranges for cattle. Today, after a 30% and 50% reduction of sheep and cattle, respectively, the range lands on the public lands within the upper Ruby are managed on a rest rotation grazing system. Other land uses in the upper Ruby Valley include recreation in the form of fishing, hunting and camping, logging and limited amounts of mining.

The soils of the upper Ruby River valley are highly susceptible to erosion and mass wasting (Page, 1978). The overgrazing of these areas in the late 1800's resulted in the formation of extensive rills and gullies. A riparian zone survey conducted in 1976 identified 621 bank instability sites on the upper 14 miles of river (Haugen, 1977). Livestock and livestock related activities were the apparent cause at 46% of these sites.

The deposition of extremely fine sediments in the main river as well as the major tributaries in the upper drainage is a serious problem potentially affecting trout food production and incubating trout eggs. Due to severe sediment deposition, the intergravel water permeability in most trout spawning areas is below the level needed for good survival of incubating trout eggs (Haugen, 1977).

The USGS operated a gage on the upper Ruby River 3.1 miles upstream from the head of Ruby Reservoir. The mean annual flow for a 41-year period of record was 177 cfs. Mean monthly flows ranged from 102 cfs (for February) to 464 cfs (for June). Water to irrigate about 3,000 acres is diverted above this site.

GAME FISH PRESENT: Rainbow trout, mountain whitefish, brown trout.

FISHERY:

In August, 1976, a 4,100 ft section of the upper Ruby River at the USFS boundary and downstream from the mouth of Warm Springs Creek was electrofished (Peterson, 1979). Game fish captured in descending order of abundance were rainbow trout, mountain whitefish and brown trout. Mottled sculpin, longnose dace and longnose, white and mountain suckers were the non-game species present (Table 2-34). This section supported an estimated 137 pounds of game fish per 1,000 ft (Table 2-35).

Table 2-34. Summary of electrofishing survey data collected for a 4,100 ft section of the upper Ruby River (T9S, R3W, Sec. 17C and 18D) on August 11 and 25, 1976.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	564	3.4 - 13.5
Mountain whitefish	83	8.3 - 15.5
Brown trout	32	11.9 - 18.2
Longnose dace	-	-
Mottled sculpin	-	-
Longnose sucker	-	-
White sucker	-	-
Mountain sucker	-	-

Table 2-35. Estimated standing crops of game fish in a 4,100 ft section of the upper Ruby River (T9S, R3W, Sec. 17C and 18D) on August 11, 1976. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.0 - 5.9	281	
	6.0 - 9.9	228	
	10.0 - 13.5	40	
		549(±123)	83(±14)
Brown trout	14.0 - 18.2	16(±7)	22(±10)
Mountain whitefish	10.0 - 15.5	43(±14)	34(±12)
Total game fish		608(±124)	137(±21)

Four additional sections of the upper Ruby River up to 7,125 ft in length were also electrofished in 1976 (Peterson, 1979). The rainbow trout was the predominant game fish in these sections. Game fish standing crop estimates obtained for all five sections are compared in Figure 2-38.

The biomass of game fish in the section immediately below the confluence of Warm Springs Creek was 4-7 times greater than the biomass in the three sections upstream from the confluence. Several factors, including the flow contribution of Warm Springs Creek and a general improvement in bank cover, may be causing this increase. Game fish populations again substantially decrease as the river progresses downstream from Warm Springs Creek. Irrigation diversions, poor aquatic habitat conditions resulting from overgrazing, and the progressive dilution of the flow of Warm Springs Creek are probably contributing to this decline. Overall, game fish populations throughout much of the upper Ruby River are depressed for a stream of its size.

WILDLIFE:

Lands adjacent to Reach #1 of the Ruby River support year-round populations of mule and white-tailed deer, moose, elk and antelope. Otter, mink and beaver are the primary resident furbearers. The river is used extensively by waterfowl during fall and spring migrations and provides fair waterfowl production during the spring-summer breeding season. Nesting waterfowl include teal, mallard, merganser and Canada goose. Bald eagles winter along the river and a population of golden eagles, rated as excellent, is present year-round.

WETTED PERIMETER:

A 155 ft section of the upper Ruby River at the USFS boundary (T9S, R3W, Sec. 18D) was selected for the collection of cross-sectional data. Five cross-sections defining the riffle-pool sequence were established. The WETP program was calibrated to field data collected at flows of 93.4, 177.8 and 321.3 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-39. Lower and upper inflection points occur at about 50 and 125 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 102 cfs (73,845 A.F./yr)

The overall depressed fishery of Reach #1 of the Ruby River warrants a flow recommendation below 125 cfs, the upper inflection point on the wetted perimeter and flow relationship. A flow of 102 cfs, which is the base winter flow as measured at the USGS gage near the head of Ruby Reservoir, should be sufficient to protect the existing fishery. A flow of 102 cfs is, therefore, requested.

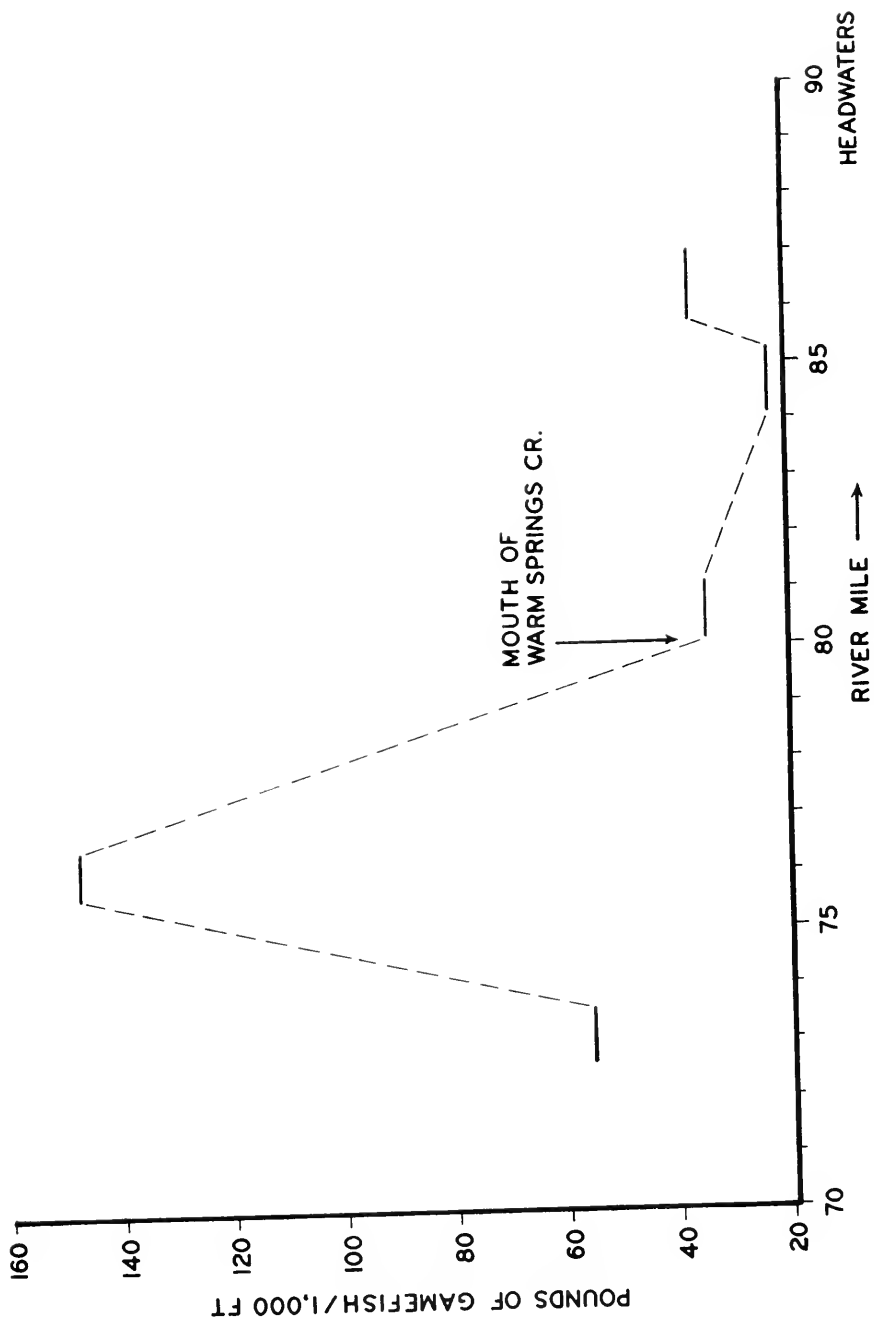


Figure 2-38. Estimated pounds of gamefish (rainbow trout, brown trout and mountain whitefish) in five sections of the upper Ruby River in 1976 (data from Peterson, 1977).

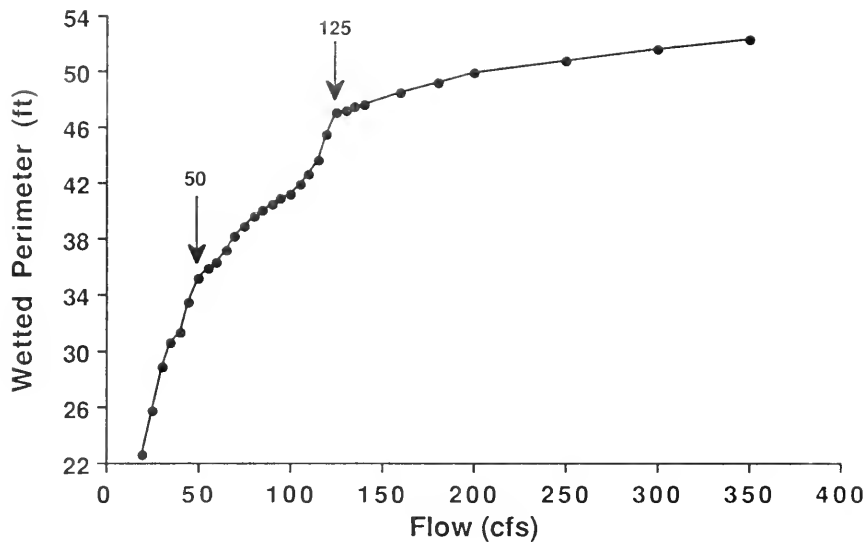


Figure 2-39. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #1 of the Ruby River.

STREAM NAME: Ruby River

STREAM REACH: #2. From Ruby Dam to the mouth - 47.9 miles

LOCATION: Sec. 8, T7S, R4W to Sec. 4, T4S, R6W

DESCRIPTION OF STREAM REACH:

Reach #2 of the Ruby River meanders for 47.9 miles through private grazing and irrigated hay lands within the wide, open Ruby Valley. Channel and bank alterations are common within this stretch. As of 1973, a total of 280 river bank and 53 channel alterations were documented. They comprised 17 and 8 percent, respectively, of the reach length.

Public access to Reach #2 is limited to bridge sites and a few private ranches in which permission of the landowners is required. Except for a short BLM parcel by the dam, lands abutting the river are all privately owned.

A major concern in the lower river is excessive sedimentation. Overgrazing of the upper drainage coupled with the fragile soil types of the area have resulted in erosion problems and the accumulation of vast sediment deposits in Ruby Reservoir. During periods of extreme drawdown, the discharge from Ruby Reservoir is excessively turbid. This is attributed to bottom sediments being drawn into suspension by currents generated on the reservoir floor. The destruction of stream bank vegetation by livestock has further aggravated the sediment problem in Reach #2.

Invertebrate sampling below the dam shows a decreased biomass due to sedimentation of the substrate (Greene et al., 1971). Combined totals of the orders Coleoptera (aquatic beetles) and Plecoptera (stoneflies), groups especially susceptible to silt deposition, were never documented in greater concentrations than two individuals per square foot. However, the order Ephemeroptera (mayflies) averaged greater than 51 individuals per square foot. This was attributed to the mud burrowing forms of mayflies.

Another serious problem affecting the aquatic resource of Reach #2 is stream dewatering. When water is stored in Ruby Reservoir during the winter months, flows below the dam are greatly reduced. Portions of the river are also subject to severe dewatering during the summer irrigation season. During the droughts of 1985 and 1987, stretches of Reach #2 were totally dewatered, causing major fish kills.

The USGS operated a gage near the mouth of the Ruby River at river mile 2.1 from 1941-65. The mean annual flow for a 20-year period of record was 196 cfs. Mean monthly flows ranged from 139 cfs (for February) to 361 cfs (for June). Water to irrigate about 28,500 acres is diverted above this site.

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout

FISHERY:

The brown trout is the dominant trout species in Reach #2. Brown trout occasionally reach weights of 3 pounds and greater. Other species present in order of declining abundance are mountain whitefish, mottled sculpin, longnose sucker, white sucker, longnose dace and rainbow trout. In 1973, estimates of the number of age I and older brown trout in study sections below the dam ranged from 81 to 255 per 1,000 ft of river. The variation was shown to be strongly associated with the quality of habitat, while it was inversely related to channel and streambank alterations (Peterson, 1974).

More recent estimates are available for a 7,920 ft-long-tailwater section below Ruby Dam and a 16,500 ft section near the river's mouth. In the spring of 1984, the tailwater section supported an estimated 217 age II and older (about 8 inches and longer) brown trout, weighing 137 pounds, per 1,000 ft of stream. Most of the trout were between 10 and 14 inches, with about 3 percent of the population 15 inches and longer. This is a fair population for a river of this size. The lower study section in spring of 1982 supported an estimated 120 age II and older (about 8 inches and longer) brown trout, weighing 67 pounds, per 1,000 ft. Given more adequate flows during the summer irrigation season and the winter reservoir storage period, the river is capable of sustaining a greater biomass of trout than presently occurs.

Reach #2 has been identified as an important reproductive site for brown trout from the Jefferson River. Electrofishing and tagging studies begun in 1981 show that a strong run of Jefferson River brown trout - some originating as far downstream as Three Forks, a distance of about 85 miles - ascends the Ruby River each fall to spawn. Spawners from the Beaverhead River and as far away as the Madison River have been captured in the Ruby River as well.

WILDLIFE:

Lands along Reach #2 of the Ruby River support year-round populations of white-tailed deer and mule deer rated as excellent and good, respectively. Black bear, moose, mountain lion and bobcat are occasionally found along the river. The primary resident furbearers are mink, beaver and otter. Upland game birds inhabiting the riparian area and adjacent fields are ring-necked pheasant and Hungarian partridge. Reach #2 is an excellent waterfowl area during the spring and fall migrations and provides good waterfowl production during the spring-summer breeding season. Nesting waterfowl include teal, mallard, merganser and Canada goose. Bald eagles nest along Reach #2, spending the winter as well.

WETTED PERIMETER:

Cross-sectional measurements were made in an approximate ¼-mile section of Reach #2 of the Ruby River near its mouth (Sec. 3C, T4S, R6W). Five riffle cross-sections were established; however, one cross-section was discarded due to calibration problems. The WETP program was calibrated to field data collected at flows of 32.1, 58.0 and 113.8 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections (Figure 2-40) shows lower and upper inflection points at approximate flows of 25 and 40 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain important spawning and rearing habitats for the brown trout population of the Jefferson River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 40 cfs (28,959 A.F./yr)

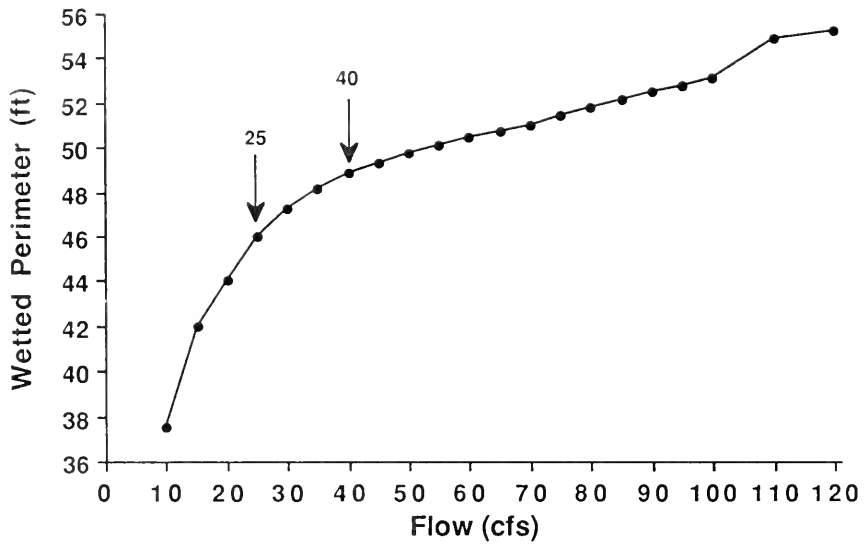


Figure 2-40. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Reach #2 of the Ruby River.

STREAM NAME: Coal Creek

STREAM REACH: From the headwaters to the mouth - 8 miles

LOCATION: Sec. 29, T11S, R2W to Sec. 29, T11S, R3W

DESCRIPTION OF STREAM REACH:

Coal Creek originates in the Gravelly Range near Monument Hill and flows northwest for about 8 miles before entering the Middle Fork of the Ruby River. It drains an area of approximately 19 square miles, all within the Beaverhead National Forest.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

A 500 ft section of Coal Creek located at about stream mile 0.5 was electrofished in 1987. Cattle grazing is the predominant land use along this portion of stream. The creek flows through a riparian zone vegetated with willow and grass. An abundance of rock occurs within the stream banks. Extremely high stream flows in the past, coupled with an unstable geology and sensitive soils, have produced an unstable stream channel. Channel gradient is relatively low (near two percent) and the streambed is comprised of cobble, gravel and sand.

The only game fish captured in Coal Creek was the westslope cutthroat trout. Species identification was based solely on external morphological characteristics.

A population estimate conducted in the above section in August, 1987 found 422 westslope cutthroat trout 3.0 inches and longer per mile, with 190 of these 6.0 inches and longer. The cutthroat captured averaged 6.4 inches in length.

WILDLIFE:

The Coal Creek drainage is noted for its outstanding big game habitat. Elk and mule deer are present from spring through fall, while moose and black bear are year-round residents. Other resident species of interest include bobcat, coyote and mountain lion.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.6 cfs (2,606 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Coal Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 48% of the average annual flow is being requested for those Ruby River tributaries having high fishery values. An average annual flow of 7.6 cfs was estimated by the USGS for Coal Creek. An instream flow of 3.6 cfs is, therefore, requested.

STREAM NAME: Middle Fork Ruby River

STREAM REACH: From the confluence of Divide Creek to the mouth - 10.9 miles

LOCATION: Sec. 7, T12S, R3W to Sec. 5, T11S, R3W

DESCRIPTION OF STREAM REACH:

The Middle Fork Ruby River originates in the Gravelly and Snowcrest Ranges in southwest Montana approximately 36 miles south of the town of Alder, Montana. It flows for about 11.5 miles before converging with the East and West Forks to form the Ruby River. The 55.4 square mile drainage, which consists of sagebrush covered lowlands and sparsely timbered foothills and mountains, is controlled entirely by the USFS. Major tributaries to the Middle Fork Ruby River include Basin, Corral, Shovel, Deer, Poison, Hawkeye and Bear Creeks. The 20 ft wide, meandering channel has a gradient of 12 ft per 1,000 ft. The riparian zone is vegetated with birch, alder, willow, grasses and forbs. A graveled road parallels the stream its entire length. Cattle and sheep grazing and recreation are the primary land use activities in the Middle Fork drainage.

The effects of past and present land use activities, especially livestock grazing, on the fragile and easily erodible soils of the upper Ruby River Valley have been debated for over a decade. Haugen (1977) found bank instability in the Ruby drainage to be the greatest above the three forks. Much of the instability was attributed to livestock or livestock related activities. The USFS identified a general deteriorating habitat trend in the Middle Fork, with specific limiting factors being the sedimentation of riffles, inadequate pool development, bank scour and a generally highly erosive drainage.

The USFS collected sporadic flow data for the Middle Fork from May through September, 1975-1976. Flows during this period ranged from 14.4 cfs in August, 1975 to 224.3 cfs in June, 1975. The highest recorded flow in 1976 was 79.2 cfs in June. It should be noted that 1975 and 1976 were the highest and fifth highest water years, respectively, in a 38-year period of record for the upper Ruby drainage. No water is presently being diverted from the stream.

GAME FISH PRESENT: Rainbow x cutthroat hybrid trout, cutthroat trout, rainbow trout.

FISHERY:

A 1,650 ft section of the Middle Fork Ruby River was electrofished on August 20 and 25, 1970 (Elser and Marcoux, 1972). A 2,643 ft section in the immediate vicinity of the 1970 section was electrofished on September 19, 26 and 30, 1975 (Peterson, 1976). Game fish present were cutthroat trout, rainbow trout and rainbow x cutthroat hybrids. The mottled sculpin was the only non-game species captured. The 1970 and 1975 electrofishing survey data are summarized in Table 2-36.

Table 2-36. Summary of electrofishing survey data collected for a 1,650 ft section of the Middle Fork Ruby River (T11S, R3W, Sec. 7D) on August 20 and 25, 1970 and a 2,643 ft section (T11S, R3W, Sec. 7D) on September 19, 26 and 30, 1975.

Fish Species	Number Captured		Length Range (inches)	
	1970	1975	1970	1975
Cutthroat trout	12	12	4.2-10.3	5.0-11.8
Rainbow trout	11	2	6.4-10.1	6.0- 9.7
Rainbow x cutthroat hybrids	11	31	4.7-10.9	5.0-11.6
Mottled sculpin	-	-	-	-

The standing crop of trout in the sections was estimated using a mark-recapture method (Table 2-37). In 1970, the Middle Fork supported an estimated 6 pounds of trout per 1,000 ft of stream and, in 1975, 8 pounds per 1,000 ft. Of the streams electrofished in the Beaverhead National Forest, the Middle Fork Ruby River supported one of the lowest trout populations.

Table 2-37. Estimated standing crop of trout in a 1,650 ft section of the Middle Fork Ruby River (T11S, R3W, Sec. 7D) on August 20, 1970 and a 2,643 ft section (T11S, R3W, Sec. 7D) on September 19, 1975. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft			
		1970		1975	
		Number	Pounds	Number	Pounds
Rainbow, cutthroat	4.2 - 5.9	2		5	
and rainbow x cut-	6.0 - 9.9	16		30	
throat hybrid trout	10.0 - 11.8	9		6	
		27(±6)	6(±2)	41(±17)	8(±3)

WILDLIFE:

The Middle Fork drainage provides seasonal range for mule deer and elk from spring through mid-winter and year-round range for moose. Important deer fawning and elk calving grounds are found within the Middle Fork basin. An occasional black bear is present and antelope are seasonal inhabitants from spring through fall. Beaver and mink are the primary furbearers and sage grouse the principal game bird.

WETTED PERIMETER:

Cross-sectional data were collected in a 106 ft section of the Middle Fork Ruby River (T11S, R3W, Sec. 5B). Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 11.2, 42.5 and 96.7 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-41. Lower and upper inflection points occur at flows of about 5 and 9 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5.0 cfs (3,620 A.F./yr)

Because the trout population of the Middle Fork is severely depressed, the probable result of past and present grazing abuses within the drainage, the flow at the low inflection point (5.0 cfs) is recommended.

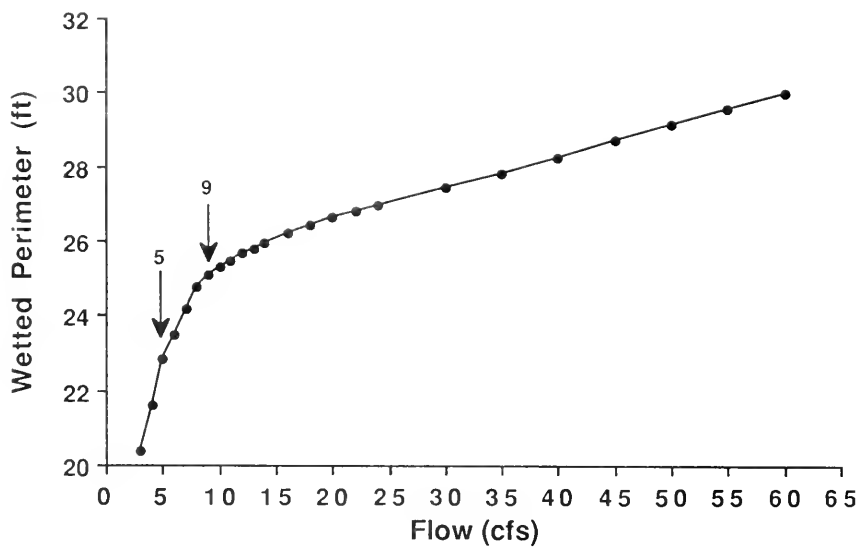


Figure 2-41. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the Middle Fork Ruby River.

STREAM NAME: East Fork Ruby River

STREAM REACH: From the headwaters to the mouth - 7.9 miles

LOCATION: Sec. 17, T11S, R2W to Sec. 5, T11S, R3W

DESCRIPTION OF STREAM REACH:

The East Fork Ruby River originates in the Gravelly Range of southwest Montana and flows for 7.9 miles in a northeasterly direction before converging with the West and Middle Forks to form the Ruby River. The 16.3 square mile drainage is controlled entirely by the USFS. Although there are numerous small tributaries to the East Fork Ruby River, Tributary Creek is the only named stream. The East Fork Ruby River has a fairly steep gradient of 50 ft per 1,000 ft. The riparian zone is vegetated with willow, birch, alder and cinquefoil. The bottom substrate of the 15 ft wide channel consists primarily of boulder and cobble.

Lands within the East Fork Ruby River drainage are primarily used for cattle and sheep grazing and recreation in the form of hunting, fishing and camping. A cow camp is located on the lower portion of the stream near the mouth. Other than a road paralleling the lower mile and headwater area, this stream is accessible only by foot or horse.

The effects of past and present land use practices, especially livestock grazing, on the fragile and highly erosive soils of the East Fork Ruby River drainage have been debated for the past decade. Page (1978) attributed extensive gully and rill formation near the crest of the Gravelly Range to grazing abuse early in the century. This land deterioration has concentrated and increased runoff in the East Fork Ruby River drainage. The average annual suspended sediment yield for the East Fork during 1975-1976 was 246 tons/square mile of drainage, second only to Cottonwood Creek in the upper Ruby River drainage. The USFS identified poor habitat conditions, extensive bank and bottom scour, inadequate pool development and stock trampling as factors affecting the aquatic resource.

Flows have been sporadically measured by the USFS from May through September, 1975-1976. Flows ranged from a low of 6.9 cfs in September, 1975 to a high of 140.7 cfs in July, 1975. The highest recorded flow for 1976 was 132.6 cfs in late May. It should be noted that 1975 and 1976 were the highest and fifth highest water years, respectively, in a 38-year period of record for the Ruby River drainage. No water is presently being diverted from the East Fork.

GAME FISH PRESENT: Rainbow trout, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 2,000 ft section of the East Fork Ruby River was electrofished in August, 1970 and a 3,566 ft section was electrofished in September, 1975 (Elser and Marcoux, 1972 and Peterson, 1976). Game fish captured were rainbow trout, cutthroat trout and rainbow x cutthroat hybrids. The mottled sculpin was the only non-game species present (Table 2-38).

Table 2-38. Summary of electrofishing survey data collected for a 2,000 ft section of the East Fork Ruby River (T11S, R3W, Sec. 5) on August 19 and 25, 1970 and a 3,566 ft section (T11S, R3W, Sec. 5) on September 19, 26 and 30, 1975.

Fish Species	Number Captured		Length Range (inches)	
	<u>1970</u>	<u>1975</u>	<u>1970</u>	<u>1975</u>
Rainbow trout	46	30	3.7-13.6	4.0-15.0
Cutthroat trout	-	6	-	4.0- 8.8
Rainbow x cutthroat hybrids	26	18	4.2-10.6	6.1- 8.5
Mottled sculpin	-	-	-	-

The standing crop of trout in the 2,000 ft section was estimated in 1970 using a mark-recapture method (Table 2-39). This section supported about 47 trout 4.0 inches and longer, weighing 6 pounds, per 1,000 ft of stream. This population is severely depressed when compared to other streams electrofished in the Beaverhead National Forest. Of the three forks of the Ruby River, the East Fork supported the lowest trout biomass.

Table 2-39. Estimated standing crop of trout in a 2,000 ft section of East Fork Ruby River (T11S, R3W, Sec. 5) on August 19, 1970. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow and rainbow x cutthroat hybrid trout	4.0 - 5.9	28	
	6.0 - 9.9	15	
	10.0 - 13.6	<u>4</u>	
		47(±10)	6(±2)

WILDLIFE:

The East Fork drainage provides seasonal range for mule deer and elk from spring through mid-winter and year-round habitat for moose. Important deer fawning and elk calving grounds are within the basin. An excellent black bear population is present as well as an occasional grizzly bear. Beaver and mink are the primary furbearers and blue grouse the principal game bird.

WETTED PERIMETER:

Cross-sectional data were collected in a 50 ft section of the East Fork Ruby River near the mouth (T11S, R3W, Sec. 5B). Five cross-sections describing the riffle-run habitat were established. The WETP program was calibrated to field data collected at flows of 7.9, 24.2 and 34.3 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-42. Lower and upper inflection points occur at flows of about 3 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.0 cfs (2,172 A.F./yr)

Because the trout population of the East Fork is severely depressed, the probable result of past grazing abuse within the drainage, the flow at the low inflection point (3.0 cfs) is recommended.

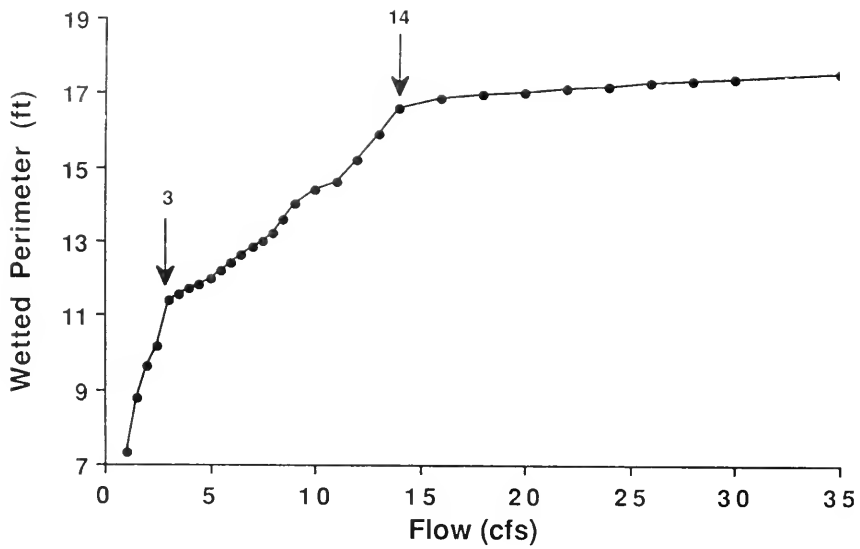


Figure 2-42. The relationship between wetted perimeter and flow for a single riffle cross-section in the East Fork Ruby River.

STREAM NAME: West Fork Ruby River

STREAM REACH: From the headwaters to the mouth - 7.7 miles

LOCATION: Sec. 17, T11S, R4W to Sec. 5, T11S, R3W

DESCRIPTION OF STREAM REACH:

The West Fork Ruby River originates in the Snowcrest Range of southwest Montana and flows in a northeasterly direction for 7.7 miles before converging with the Middle and East Forks to form the Ruby River. Lands within the 21.5 square mile drainage are entirely within the Beaverhead National Forest. Major tributaries include Timber, Noname, Beaver, Big Spring, Coal Spring and Yakama Creeks. The 12 ft wide channel has a fairly steep gradient of 63 ft/1,000 ft. The riparian zone is vegetated with alder, birch, cinquefoil, willow and grasses. The bottom substrate is composed of gravel and cobble. The upper drainage consists of sparsely timbered slopes while the lower portion is comprised of grassland-sagebrush communities. An undeveloped road parallels the stream between its mouth and headwaters. Lands within the West Fork Ruby River drainage are primarily used for sheep and cattle grazing and recreation in the form of hunting, fishing and camping.

The effects of past and present land use activities, especially livestock grazing, on the fragile and easily erodible soils of the West Fork drainage have been debated for the past decade. Haugen (1977) found that the West Fork had the highest entrapped bedload, which consisted of extremely fine material, in the upper Ruby River drainage. The West Fork Ruby River also had the third highest suspended sediment level in a study of 14 stations in the Ruby drainage (Page, 1978). The average sediment yield for 1975-1976 was 201 tons/square mile or 12% of the total suspended sediment in the Ruby River.

The USFS collected sporadic flow data for the West Fork from May through October, 1975-1976. Flows ranged from a low of 8.8 cfs in October, 1975 to a high of 107.6 cfs in July, 1975. The highest flow recorded in 1976 was 48.6 cfs in June. It should be noted that 1975 and 1976 were the highest and fifth highest water years, respectively, for a 38-year period of record for the Ruby drainage. No water is presently being diverted from the West Fork.

GAME FISH PRESENT: Rainbow x cutthroat hybrid trout, cutthroat trout, rainbow trout, mountain whitefish.

FISHERY:

A 1,900 ft and 4,125 ft section of the West Fork Ruby River was electrofished in August, 1970 and September, 1975, respectively (Elser and Marcoux, 1972 and Peterson, 1976). Game fish present during both years were rainbow and cutthroat trout, rainbow x cutthroat trout hybrids and mountain whitefish. The mottled sculpin was the only non-game species captured. The electrofishing survey data for both years are summarized in Table 2-40.

Table 2-40. Summary of electrofishing survey data collected for a 1,900 ft section of the West Fork Ruby River (T11S, R3W, Sec. 5 and 6) on August 19 and 25, 1970 and a 4,125 ft section (T11S, R3W, Sec. 5 and 6) on September 16 and 30, 1975.

Fish Species	Number Captured		Length Range (inches)	
	<u>1970</u>	<u>1975</u>	<u>1970</u>	<u>1975</u>
Cutthroat trout	-	16	-	5.3-10.4
Rainbow trout	5	4	5.4-13.1	6.2-15.5
Rainbow x cutthroat hybrid trout	19	14	6.2-10.8	6.1-12.4
Mountain whitefish	4	-	10.7-15.2	-
Mottled sculpin	-	-	-	-

The standing crop of trout in the 1,900 ft section was estimated in 1970 using a mark-recapture method (Table 2-41). This section supported about 32 trout, weighing 12 pounds, per 1,000 ft of stream. Of the streams electrofished in the Beaverhead National Forest, the West Fork Ruby River supported one of the lowest standing crops of trout. Few of the trout captured were less than 7 inches, suggesting reproduction problems. The scarcity of silt-free spawning areas and/or the inability of trout eggs to survive in the silt-laden gravels may be responsible for the low numbers of smaller trout. Immigration from tributary streams may be the only form of recruitment to the West Fork trout population.

Table 2-41. Estimated standing crop of trout in a 1,900 ft section of the West Fork Ruby River (T11S, R3W, Sec. 5 and 6) on August 19, 1970. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	<u>Per 1,000 ft</u>	
		Numbers	Pounds
Rainbow and rainbow x cutthroat hybrid trout	5.4 - 5.9	1	
	6.0 - 9.9	16	
	10.0 - 13.1	<u>15</u>	
		32(±12)	12(±4)

WILDLIFE:

The West Fork drainage provides seasonal range for mule deer and elk from spring through mid-winter and year-round range for moose. Important deer fawning and elk calving grounds are within the basin. An excellent black bear population is present. Beaver and mink are the primary furbearers and the blue grouse the principal game bird.

WETTED PERIMETER:

A 61 ft section of the West Fork Ruby River near its mouth (T11S, R3W, Sec. 5B) was selected for the collection of cross-sectional data. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 10.6, 14.1 and 31.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-43. A prominent upper inflection point occurs at a flow of about 6 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.0 cfs (2,172 A.F./yr)

The depressed fishery of the West Fork does not warrant a flow recommendation at the upper inflection point. Because a low inflection point was not discernible on the wetted perimeter-flow relationship, a flow at $\frac{1}{2}$ the upper inflection point (3.0 cfs) is recommended.

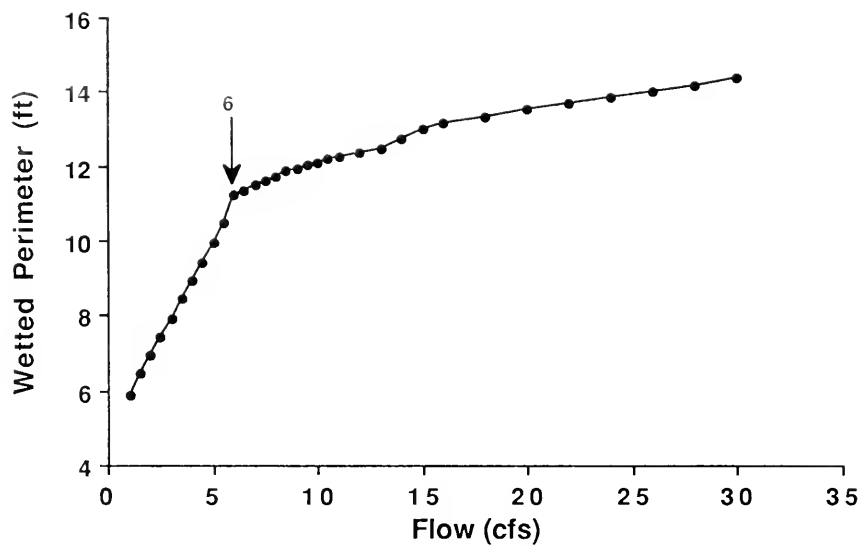


Figure 2-43. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the West Fork Ruby River.

STREAM NAME: Cottonwood Creek

STREAM REACH: From the confluence of Geyser Creek to the mouth - 6.2 miles

LOCATION: Sec. 31, T10S, R2W to Sec. 9, T10S, R3W

DESCRIPTION OF STREAM REACH:

Cottonwood Creek originates in the Gravelly Range approximately 34 miles south of Alder, Montana. The stream flows in a northeasterly direction for 10.1 miles before entering the Ruby River. The 21.3 square mile drainage is entirely within the Beaverhead National Forest. Cottonwood Creek has a fairly steep gradient of 59 ft/1,000 ft. It flows through sparsely timbered slopes in its upper reaches and mountain grassland/sagebrush communities in its lower reaches. The riparian zone is vegetated with alder, birch, rose, willow, aspen and various grasses. Major tributaries include the North Fork Cottonwood, Geyser and Iron Creeks. The bottom substrate within the 25 ft wide channel consists of boulder, cobble and gravel. Gravel roads provide access to the upper and lower reaches of the stream. A USFS campground and picnic area are located along the lower portion of Cottonwood Creek.

Lands within the Cottonwood Creek drainage are primarily used for sheep and cattle grazing and recreation in the form of hunting, fishing and camping. The effects of past and present land use activities, especially livestock grazing, on the highly erosive soils of the upper Ruby River drainage have been a point of debate and controversy in recent years.

Page (1978) found extensive rill and gully formation in the upper Cottonwood Creek drainage, which he attributed to past overuse by livestock. Twenty-three percent of the annual sediment yield in 1975-1976 in the upper Ruby River was contributed by Cottonwood Creek. This amounted to 377 tons/square mile of drainage (Page, 1978). Upper channels are very confined and of a highly erosive nature with 20-30 ft vertical raw banks. Suspended sediment and turbidity readings in Cottonwood Creek were the highest and second highest, respectively, out of 14 sampling stations in the upper Ruby drainage (Page, 1978). In a 1970 study, Cottonwood Creek was found to have the highest average turbidity reading of the 39 stations sampled in the Ruby-Beaverhead River drainages (Elser and Marcoux, 1972).

The USFS collected flow data sporadically from May through October of 1972-1976 (Page, 1978). Flows in Cottonwood Creek ranged from a low of 3.8 in September, 1972 to a high of 161.4 cfs in June of 1975. The highest recorded flow in 1976 was 101.7 cfs in May. It should be noted that the 1975 and 1976 water years were the highest and the 5th highest, respectively, for a 38-year period of record for the Ruby drainage.

GAME FISH PRESENT: Rainbow trout, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section located near the mouth of Cottonwood Creek (T10S, R3W, Sec. 9D) was electrofished on July 22, 1980. Four rainbow trout, ranging from 5.9-11.3 inches, and one 15.5 inch cutthroat trout were

captured. Other species collected were mottled sculpin and longnose dace. Of the 5 trout captured, none were less than 5.9 inches, suggesting poor reproduction in the stream.

Haugen (1975) electrofished three sections of Cottonwood Creek in 1974. He found no game fish in the section corresponding to the 1980 study section, one cutthroat trout in the middle section and no game fish in the upper section. He believed that bank instability and the lack of adequate stream cover, pools and spawning areas were limiting the fishery.

On August 8, 1987, a 500 ft section of Cottonwood Creek near the middle of the drainage (T10S, R3W, Sec. 25B) was electrofished by Brad Shepard, fishery biologist on the Beaverhead National Forest. The section supported an estimated 20 (± 2 at an 80% CI) rainbow x cutthroat hybrids 6.0 inches and longer, weighing 4 pounds, per 1,000 ft of stream. Four captured hybrids less than 6.0 inches were not included in the estimate. Based on an examination of external morphological characteristics, Shepard felt that there were no pure westslope cutthroat trout in the section, although pure westslopes may inhabit other portions of the Cottonwood Creek drainage.

WILDLIFE:

The Cottonwood Creek drainage provides seasonal range for mule deer and elk from spring through mid-winter and year-round habitat for moose. Important deer fawning and elk calving grounds are located within the drainage. An excellent black bear population is present as well as an occasional grizzly bear. Resident furbearers include beaver, mink and bobcat. Blue and sage grouse are the resident game birds.

WETTED PERIMETER:

Cross-sectional measurements were made in a 79 ft riffle-run sequence located near the mouth of Cottonwood Creek (T10S, R3W, Sec. 9D). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 5.3, 22.7 and 29.8 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-44. Lower and upper inflection points occur at about 4 and 7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4.0 cfs (2,896 A.F./yr)

Based on existing electrofishing data, the fishery of Cottonwood Creek appears limited. The flow at the low inflection point (4.0 cfs) is therefore requested.

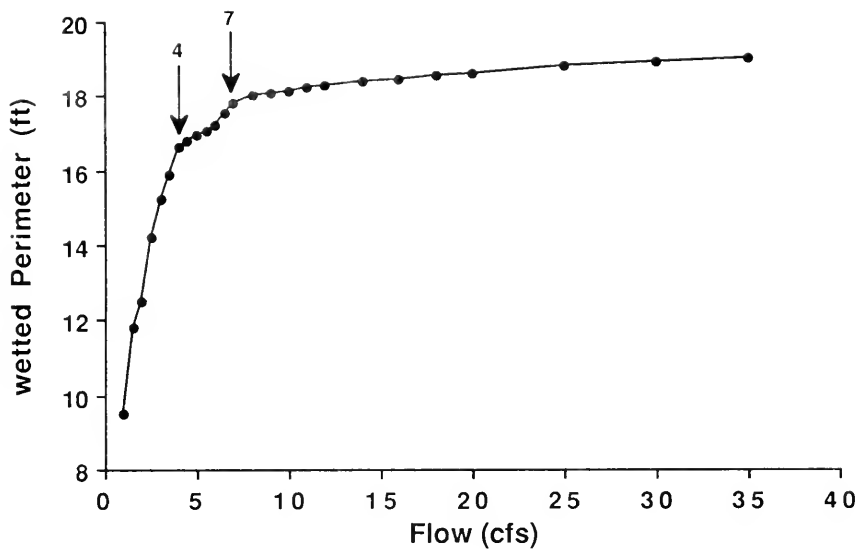


Figure 2-44. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Cottonwood Creek.

STREAM NAME: Warm Springs Creek

STREAM REACH: From the Romy Lake outlet to the mouth - 7.7 miles

LOCATION: Sec. 26, T8S, R3W to Sec. 21, T9S, R3W

DESCRIPTION OF STREAM REACH:

Warm Springs Creek flows in a westerly direction for 9.4 miles before entering the Ruby River 3.5 miles above the USFS boundary. It flows through a broad valley bordered by the steep, rocky Greenhorn Range on the west and the more gentle Gravelly Range on the east. Ninety-eight percent of its 48.8 square mile drainage is controlled by the USFS. The remaining 2% is owned by private individuals and miners. Vegetative cover within the drainage consists of 72% grassland/sagebrush, 14% forest, 10% noncommercial forest and rock slopes, 2% subalpine grassland and 2% willow bottom and wet meadows (Haugen, 1977). The riparian zone is vegetated with conifer, willow, birch and various grasses and forbs. Tributaries include Coyote, Davis and the Middle and South Forks Warm Springs Creeks. The majority of the flow in the lower 2.5 miles originates from numerous warm springs. During the summer months these 70°F waters contribute approximately 91% of the flow in the lower stretches (Pierce, 1966). The channel has an average gradient of 39 ft per 1,000 ft.

Lands within the Warm Springs Creek drainage are used for sheep and cattle grazing, logging, mining and recreation in the form of hunting, hiking and fishing. An improved gravel road parallels the lower and upper stretches of the stream, providing easy access throughout much of the basin. Siltation, bank encroachment by agriculture, road building and overgrazing of the riparian zone have been identified as existing environmental problems in the Warm Springs Creek drainage.

Flows in Warm Springs Creek have been sporadically measured by the USFS during the snow-free months of 1972-1976. Flows during the summer season are fairly constant at 62-70 cfs. The minimum and maximum flows measured were 48.5 cfs in October, 1976 and 148.8 cfs in June, 1975, respectively. In July, 1966 Pierce (1966) measured the additive flows of the Warm Springs at 54.5 cfs.

GAME FISH PRESENT: Rainbow trout, cutthroat trout, rainbow x cutthroat hybrid trout, mountain whitefish.

FISHERY:

A 1,000 ft section located downstream from most of the warm springs was electrofished on July 22 and August 14, 1980. Game fish present were rainbow trout, cutthroat trout, rainbow x cutthroat hybrids and mountain whitefish (Table 2-42). No game fish smaller than 7.7 inches were captured. Non-game species present were longnose dace, longnose sucker, mountain sucker, and stonecat, a small member of the catfish family. This is the only mountain stream in western Montana where this species is found (Brown, 1971). The stonecat's normal habitat is lowland warm-water streams throughout the lower Missouri River drainage of Montana.

Table 2-42. Summary of electrofishing survey data collected for a 1,000 ft section of Warm Springs Creek (T9S, R3W, Sec. 22B) on July 22 and August 14, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow, cutthroat and rainbow x cutthroat hybrid trout	24	7.7 - 12.7
Mountain whitefish	3	13.6 - 14.6
Stonecat	3	4.0 - 6.1
Longnose sucker	-	-
Mountain sucker	-	-
Longnose dace	-	-

Due to the low numbers of trout captured, the standing crop could not be estimated. Although conditions appear favorable for trout, water temperatures during the summer months are evidently high enough to limit their abundance below the warm springs.

Pierce (1966) sampled three sections of Warm Springs Creek, above, within and below the inlet of the springs. When all other parameters were equal (i.e., habitat, cover, and volume of flow), he found the distribution of stonecats tied directly to temperature. Their numbers increased tenfold below the warm springs. Numbers of longnose sucker, longnose dace and mountain sucker also increased. Only trout and mottled sculpin decreased downstream from the springs.

It is believed that Warm Springs Creek, through increased water quality and quantity, increased nutrient levels and stabilizing water temperatures, has substantially improved the aquatic productivity in the Ruby River below its confluence. When comparing major nutrient levels, specific conductance, and total dissolved solids in the Ruby River above and below the confluence of Warm Springs Creek, these parameters were higher downstream (Page, 1978). The 68-70°F water of Warm Springs Creek tends to stabilize water temperatures in the Ruby River below the confluence. This warm water has a positive influence on the aquatic productivity by increasing food supply and reducing winter water temperatures and ice formation. A 4-7 fold increase in the game fish population of the Ruby River immediately below the confluence has been documented (Peterson, 1979). The flow of Warm Springs Creek is extremely important for the maintenance of game fish populations in the Ruby River.

WILDLIFE:

Year-round habitat for mule deer, moose and elk, including important winter range, is found within the Warm Springs Creek drainage. Deer fawning and elk calving grounds are also present. Antelope are seasonal inhabitants from spring through fall. Other resident big game are black bear and mountain lion. Mink and beaver are the primary furbearers within the basin, and blue and sage grouse the principal game birds.

WETTED PERIMETER:

A 153 ft section of Warm Springs Creek in T9S, R3W, Sec. 22B was selected for the collection of cross-section data. Because the majority of the flow in this section originates from springs, flows remained stable at 72-76 cfs throughout the field season. Consequently, the collection of the field data needed to calibrate the WETP program could not be completed.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect the habitat of a unique population of stonecats; to protect a high quality water source that enables the Ruby River (below the confluence of Warm Springs Creek) to support elevated game fish numbers; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 48.5 cfs (35,112 A.F./yr)

Warm Springs Creek is spring-fed and not appreciably influenced by snow-melt. Spring creeks in general are highly utilized recreational resources that can provide outstanding habitat for waterfowl, trout and other fish species. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana.

It is, therefore, recommended that the base flow of Warm Springs Creek remain instream for purposes of maintaining fish and wildlife habitat in both Warm Springs Creek and the Ruby River. Based on limited flow data, this recommendation amounts to an approximate flow of 48.5 cfs (35,112 acre-feet of water per year).

STREAM NAME: North Fork of Greenhorn Creek

STREAM REACH: From the headwaters to the mouth - 7.5 miles

LOCATION: Sec. 34, T7S, R3W to Sec. 26, T8S, R4W

DESCRIPTION OF STREAM REACH:

The North Fork of Greenhorn Creek originates on the west slope of the Greenhorn Mountains at an elevation of approximately 9,160 ft. The stream flows in a west-southwesterly direction for 7.5 miles to its juncture with the South Fork to form Greenhorn Creek, a tributary to the Ruby River. The 12.8 square mile drainage is characterized by steep, heavily timbered, north-facing slopes and south-facing slopes having numerous clearings. Ownership of the drainage is controlled by the USFS (78.8%), the BLM (19.7%) and private individuals (1.5%). The stream is bordered by a relatively broad riparian zone of willow, alder, birch, dogwood, aspen and grasses. Areas of beaver activity are found in the lower reaches of the stream. Named tributaries to the North Fork include Dark Hollow Creek and the Meadow Fork of Greenhorn Creek. The average gradient of the 9.6 ft wide channel is 81.9 ft/1,000 ft.

Lands within the drainage are used for cattle and sheep grazing and outdoor recreation in the form of hunting and fishing. Access is provided by a dirt road paralleling the stream.

The Greenhorn Creek drainage was placer mined for gold in the early 1900s. The exact locations of these placers are not known, and no indications of placer work were observed in the vicinity of the study area.

A riparian zone inventory conducted on the stream resulted in a good condition rating, while a BLM district survey rated the fish habitat as being in excellent condition (BLM, 1980).

GAME FISH PRESENT: Brook trout, westslope cutthroat trout.

FISHERY:

A 1,000 ft section of North Fork of Greenhorn Creek was electrofished on August 5 and August 18, 1982. Forty-seven brook trout, ranging from 1.5-10.2 inches, and 19 westslope cutthroat trout from 2.8-9.9 inches were captured. No other species were present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-43). No estimate of westslope cutthroat trout could be derived due to a lack of sufficient recaptured fish to insure statistical reliability. The section supported about 33 brook trout 4.0 inches and longer, weighing three pounds. Brook trout six inches and longer comprised 28% of the estimated population. Brook trout condition (length to weight ratio) was excellent.

Table 2-43. Estimated standing crop of brook trout in a 1,000 ft section of the North Fork of Greenhorn Creek (T8S, R4W, Sec. 24 BD) on August 5, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.4	21	
	5.5 - 10.2	<u>12</u>	
		33(±8)	3(±1)

Meristic examination of representative cutthroat trout collected from the North Fork of Greenhorn Creek found them to be within the range of characteristics described by Behnke (1979) and Roscoe (1974) as typifying the westslope strain of cutthroat trout. The westslope cutthroat trout, once common throughout the upper Missouri River drainage, is classified as a species of "special concern" in Montana. It has been documented that cutthroat trout are very intolerant of environmental disturbances and habitat changes, are poor competitors with introduced species, readily hybridize with rainbow trout and are highly susceptible to fishing pressure. These factors have combined to greatly reduce and restrict the native cutthroat trout populations of the upper Missouri drainage.

WILDLIFE:

The North Fork Greenhorn Creek drainage supports mule deer and elk from spring through early winter. Moose are present year-round. Other inhabitants include mountain lion, bobcat, mink and an occasional grizzly bear. The blue grouse is the primary game bird within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 136 ft riffle section located at about stream mile 1.2 (T8S, R4W, Sec. 24 BD). Approximately 93% of the drainage area was located above this site. The WETP program was calibrated to field data collected at flows of 3.0, 7.7 and 49.9 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-45. Lower and upper inflection points occur at about 1.0 and 3.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to protect critical habitat for westslope cutthroat trout; to maintain the existing resident brook trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.5 cfs (2,534 A.F./yr)

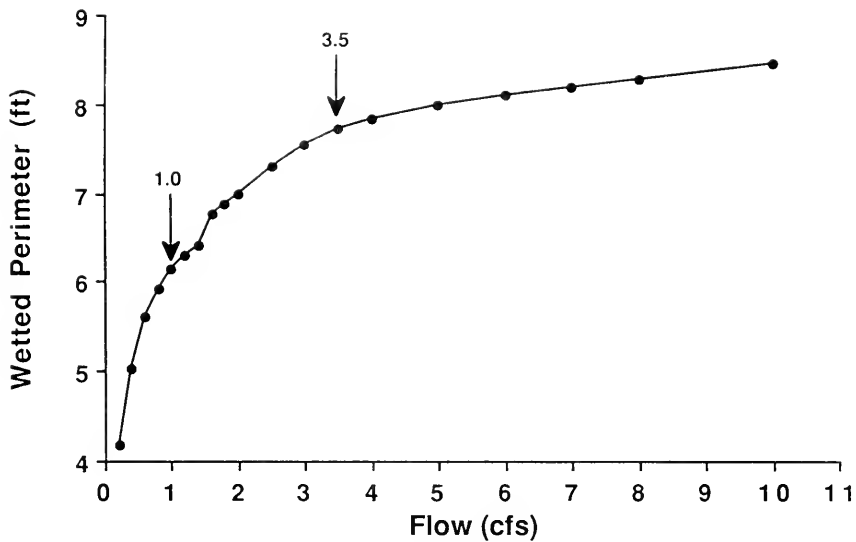


Figure 2-45. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in the North Fork Greenhorn Creek.

STREAM NAME: Mill Creek

STREAM REACH: From the outlet of Branham Lake to the mouth - 20.8 miles

LOCATION: Sec. 5, T4S, R3W to Sec. 25, T4S, R6W

DESCRIPTION OF STREAM REACH:

Mill Creek originates at Branham Lakes in the Tobacco Root Mountains of southwest Montana and flows 20.8 miles before discharging into the Ruby River near the town of Sheridan. The creek passes through a narrow canyon surrounded by conifer covered mountain slopes before entering the Ruby Valley. The upper 1/3 of the creek is within the Beaverhead National Forest while much of the lower 2/3 is privately owned. Mill Creek at low flow averages about 17.9 ft in width and the bottom substrate consists mainly of cobble-gravel.

Primary land uses in the drainage are hay and small grain production within the Ruby Valley, livestock grazing on both federal and private lands, mining, and recreation in the form of fishing (in the high mountain lakes), hiking, camping, snowmobiling and hunting. The Mill Creek drainage is particularly noted as a high use recreation area. The U.S. Forest Service maintains a developed campground along the creek and the drainage is well roaded, allowing access to the many high mountain lakes that dot the area.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A single electrofishing pass was made through 400 and 500 ft sections of Mill Creek in April, 1983. Game fish captured were brook and rainbow trout. Table 2-44 summarizes the combined catch data for the sections.

Table 2-44. Summary of combined electrofishing survey data collected for a 400 ft section (T4S, R4W, Sec. 21 CBC) and 500 ft section (T4S, R4W, Sec. 22 AA) of Mill Creek on April 27, 1983.

Fish Species	Number Captured	Length Range (inches)
Brook trout	35	2.3 - 8.2
Rainbow trout	4	3.2 - 8.0

In August, 1983, a mark-recapture population estimate was conducted in a 1,000 ft section in T4S, R4W, Sec. 22 BA. This section supported an estimated 212 brook trout from 3.5-8.8 inches, weighing a total of 22 pounds (Table 2-45). When compared to other mountain tributaries in the Ruby River basin, the trout population of Mill Creek is fairly high.

Table 2-45. Estimated standing crop of brook trout in a 1,000 ft section of Mill Creek (T4S, R4W, Sec. 22 BA) on August 10, 1983. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 5.9	123	
	6.0 - 8.8	89	
		212(±59)	22(±6)

WILDLIFE:

The Mill Creek drainage provides year-round habitat, including important winter range, for mule deer, elk, moose and mountain goat. Other resident big game species are black bear and mountain lion. Furbearers include beaver, mink, bobcat and an occasional wolverine. The blue grouse is the major game bird within the basin.

WETTED PERIMETER:

Cross-sectional data for use in the wetted perimeter inflection point method were collected in a section of Mill Creek in T4S, R4W, Sec. 23 BBC. Three riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 19.2, 28.5 and 96.0 cfs.

The wetted perimeter-flow relationship for the composite of three riffle cross-sections (Figure 2-46) shows lower and upper inflection points at flows of about 7 and 10 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

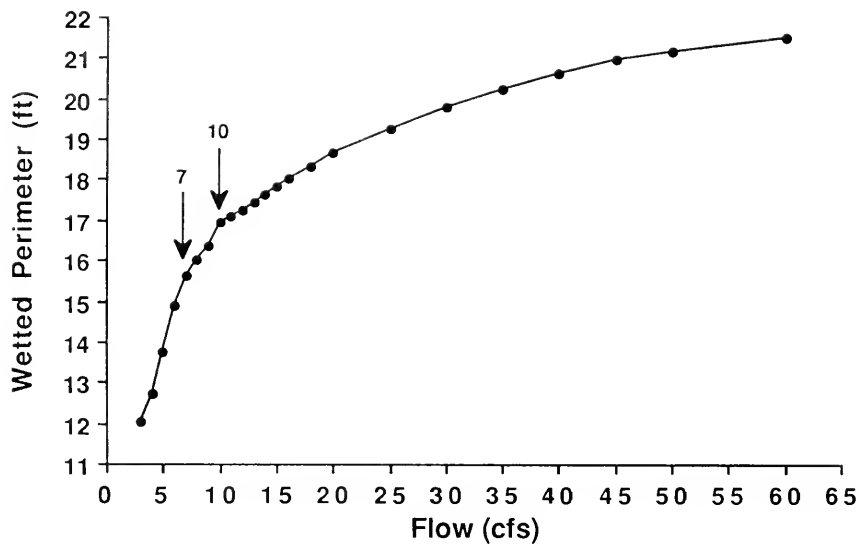


Figure 2-46. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Mill Creek.

STREAM NAME: Wisconsin Creek

STREAM REACH: From the Crystal Lake outlet to the mouth - 14.2 miles

LOCATION: Sec. 17, T3S, R4W to Sec. 14, T4S, R6W

DESCRIPTION OF STREAM REACH:

Wisconsin Creek originates at the outlet of Crystal Lake on the west slope of the Tobacco Root Mountains of southwest Montana and flows 14.2 miles before entering the lower Ruby River near the town of Sheridan. Along its upper reaches, the stream passes through a narrow canyon bordered by conifer covered slopes on the west. East and south-facing slopes are generally more open, being vegetated with sagebrush, grasses and scattered conifers. In its lower reaches, Wisconsin Creek flows through agricultural lands within the Ruby Valley. The upper 1/3 of Wisconsin Creek passes through public lands administered by the BLM and U.S. Forest Service.

Wisconsin Creek has a rubble-gravel substrate and a mean width at low flow of about 17.4 ft. The narrow riparian zone is vegetated with typical mountain plants, including cottonwood, alder, chokecherry, dogwood, aspen and willow. Access is provided by a gravel road which parallels the stream to its headwaters.

Land uses within the drainage include mining, livestock grazing on both public and private lands, irrigated hay and grain production within the Ruby Valley, and recreation in the form of fishing (in high mountain lakes), snowmobiling, hunting, and back country camping. Roving of the back country is fairly extensive and attempts to restrict road use have been undertaken by the Forest Service.

GAME FISH PRESENT: Brook trout, cutthroat trout.

FISHERY:

A 1,000 ft section of Wisconsin Creek at about stream mile 8 was electrofished on August 10 and September 3, 1983. Seventy-five brook trout, ranging from 2.3-11.4 inches, were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-46). This 1,000 ft section supported an estimated 132 brook trout 3.5 inches and longer, weighing 21 pounds. When compared to other mountain tributaries in the Ruby River basin, Wisconsin Creek supports a fairly good trout population.

Table 2-46. Estimated standing crop of brook trout in a 1,000 ft section of Wisconsin Creek (T4S, R5W, Sec. 12 AB) on August 10, 1983. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 5.9	78	
	6.0 - 9.9	48	
	10.0 - 11.4	6	
		132(±34)	21(±5)

A single electrofishing pass through the above study section on May 19, 1983 yielded, in addition to 48 brook trout, a 6.4 inch Yellowstone cutthroat trout, which was presumed to be a drifter from one of the headwater mountain lakes within the drainage.

WILDLIFE:

The Wisconsin Creek drainage provides year-round habitat, including important winter range, for moose, mountain goat, mule deer and elk. Black bear, mountain lion, bobcat, mink and an occasional beaver are also present. The blue grouse is the predominate game bird within the Wisconsin Creek basin.

WETTED PERIMETER:

Cross-sectional data for use in the wetted perimeter inflection point method were collected in a section of Wisconsin Creek in T3S, R4W, Sec. 20 DBC. Three riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 11.5, 15.4 and 47.6 cfs.

The wetted perimeter-flow relationship for the composite of three riffle cross-sections (Figure 2-47) shows lower and upper inflection points at approximate flows of 6 and 12 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 12 cfs (8,688 A.F./yr)

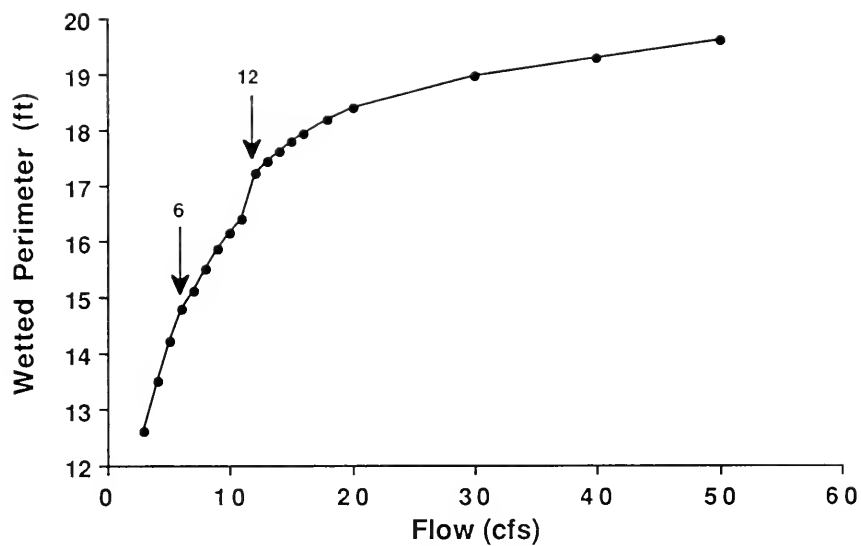


Figure 2-47. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Wisconsin Creek.

BIG HOLE RIVER SUB-BASIN

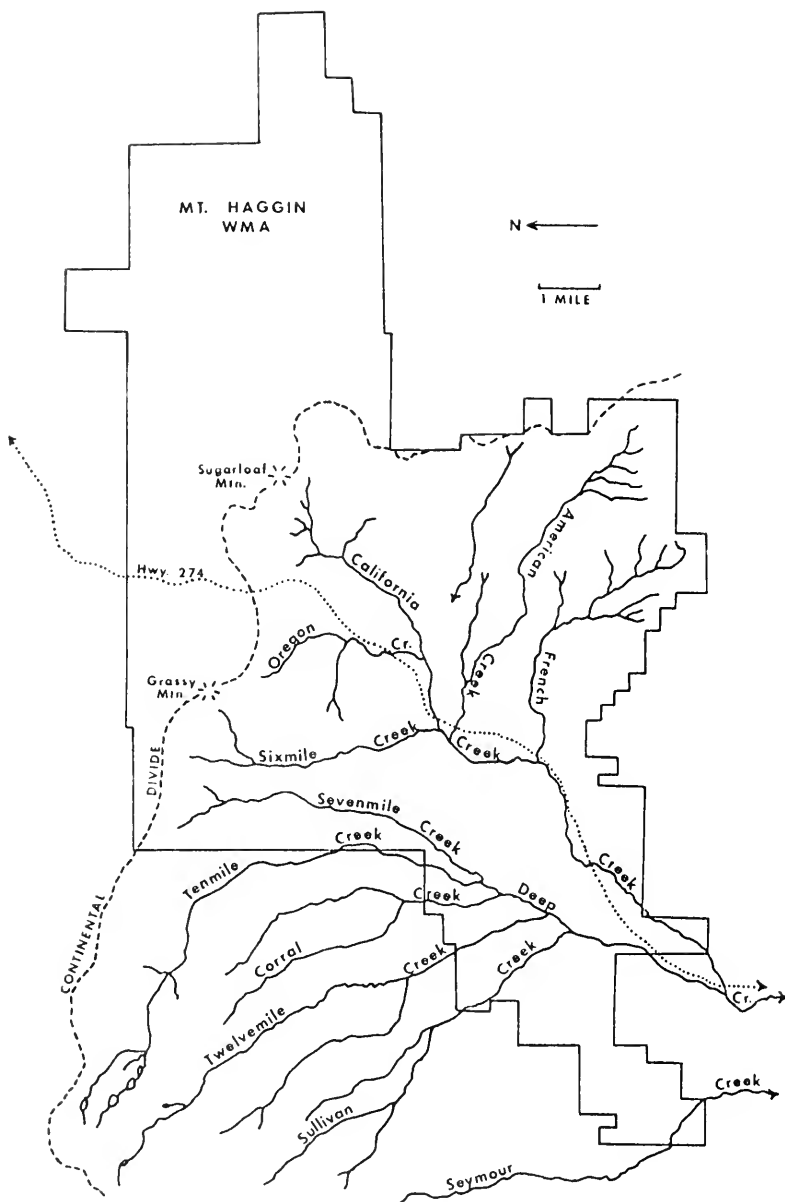


Figure 2-49. Map of the streams on the Mt. Haggin Wildlife Management Area.

STREAM NAME: Big Hole River

GENERAL DESCRIPTION OF BASIN:

The Big Hole River originates in the Bitterroot Mountains of southwest Montana at the convergence of Warm Springs Creek and the South Fork of the Big Hole River and flows 138.5 miles before joining the Beaverhead River near Twin Bridges, Montana, to form the Jefferson River. Flowing through a deep mountain valley or hole, as the Nez Pierce and early trappers called it, the river receives tributary streams from the Bitterroot Mountains on the west, the Anaconda Pintlar Range on the north and the Pioneer Mountains on the east and west. From the high mountain meadows of its headwaters to the cottonwood bottoms of the lower valley, the Big Hole is free-flowing and one of the most scenic rivers in Montana.

The headwater area is characterized by high mountain meadows, steep, timbered slopes and numerous mountain lakes. Cottonwood bottoms surrounded by sagebrush/grassland benches characterize the main river valley. Much of the valley has been converted to irrigated hay and grain fields. In addition to agriculture, lands within the drainage are also used for recreation, timber harvesting, mining and grazing. Access to the river is provided by state and county highways, which border the river for its entire length, and numerous campgrounds and fishing access sites maintained by state and federal agencies. The BLM, USFS, State of Montana and private individuals share in the ownership and management of the 2,770 square mile drainage.

The major limiting factor to the Big Hole River fishery is the severe dewatering that can occur during the summer irrigation season. Other problems affecting the aquatic resource include habitat destruction caused by channel stabilization projects and the construction of irrigation structures, the mining that is occurring along tributary streams and bank encroachment by road construction.

Water quality of the Big Hole River can generally be described as excellent, although in portions of the river it is adversely affected by dewatering, as indicated by increased summer water temperatures and associated decreases in dissolved oxygen concentrations.

The Big Hole River has long been nationally acclaimed for its wild trout fishery. Large trout have made the Big Hole famous, especially from Divide to the river's mouth. In 1959, this 56-mile section of river was given "Blue Ribbon" status in recognition of its national importance as a fishery and its high recreational and aesthetic values. From May, 1983 through April, 1984, the river provided over 49,000 angler-days of recreation, with non-residents accounting for about 33% of the pressure. Of the 9 major rivers in the upper Missouri drainage of southwest Montana, the Big Hole ranks third behind the Madison and Gallatin Rivers in total fishing pressure.

Historically, the Big Hole supported populations of westslope cutthroat trout, arctic grayling, mountain whitefish, burbot (ling), longnose dace, mottled sculpin and three species of sucker. Today, the cutthroat have all but disappeared, victims of dewatering and competition from brook, brown and rainbow trout, species introduced to the drainage. Arctic grayling - 2 classified as a species of "special concern" in Montana - remain in small

numbers in the upper river and represent the only major stream-dwelling population in the contiguous United States south of Alaska.

STREAM NAME: Big Hole River

STREAM REACH: #1. From the convergence of Warm Springs Creek and the South Fork of the Big Hole River to the confluence of Pintlar Creek
- 41.0 miles

LOCATION: Sec. 26, T5S, R15W to Sec. 8, T1S, R14W

DESCRIPTION OF STREAM REACH:

Reach #1 of the Big Hole River is 41 miles long. For most of this length, the river meanders through a wide valley and, in many places, breaks up into more than one channel, creating islands. Overhanging bank cover, comprised mostly of willows, is generally greater than that in downstream Reach #2. Willows are extremely important in this reach for providing streambank stability and overhanging cover for fish. The bottom substrate is generally finer than in the lower reaches and the gradient somewhat less steep.

Dewatering during the irrigation season represents the major threat to the fishery in Reach #1, especially in the vicinity of Wisdom. Additional water depletions during the low flow periods would have severe impacts on the fish populations. Extensive channel alterations have also occurred in Reach #1, resulting in decreased habitat for aquatic life.

Sediment loads are generally not a problem in Reach #1. However, the removal of streambank willows by mechanical means and herbicide sprays is a common practice along the upper river and has the potential for increasing bank erosion and sedimentation. Willows are extremely important for providing streambank stability, overhanging cover for fish and winter habitat and forage for moose.

GAME FISH PRESENT: Mountain whitefish, brook trout, arctic grayling, rainbow trout, cutthroat trout.

FISHERY:

Electrofishing data collected by the MDFWP show that the mountain whitefish is the most numerous game fish in Reach #1 followed by brook trout and grayling. Rainbow and cutthroat trout are uncommon, while the brown trout, the most abundant trout in the lower river, is not present. Other resident species include burbot, longnose dace, white sucker, longnose sucker, mountain sucker and mottled sculpin.

While Reach #1 supports the highest density of grayling in the Big Hole River, the population is low and continues to decline annually. In the area of Wisdom - a grayling stronghold - about 70 (6 inches and longer) grayling per mile coexist with the non-native brook (about 282 per mile) and rainbow trout (about 14 per mile).

Flow reductions due to irrigation withdrawals were identified as early as 1959 as limiting fish populations in Reach #1. Photographs taken in August of 1959 showed that the Big Hole near Wisdom was totally dewatered in one of its two channels and nearly so in the other (Heaton, 1960). This

level of dewatering is not conducive to the continued survival of the remnant arctic grayling population of the Big Hole basin.

WILDLIFE:

The headwater area of the Big Hole River provides excellent winter range for moose and, from spring through fall, seasonally supports mule deer, elk and black bear. Beaver, marten, muskrat and mink are the important furbearers in this area. Osprey and bald eagles are observed seasonally.

Reach #1 is used by nesting waterfowl and as a resting stop during spring and fall migrations. Waterfowl hunting is popular during the fall season.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of Reach #1 in Sec. 33A, T2S, R15W. Four cross-sections were established. The WETP program was calibrated to field data collected at flows of 1, 68 and 340 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections (Figure 2-50) shows lower and upper inflection points at approximate flows of 60 and 160 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect critical river habitat for the only major stream-dwelling arctic grayling population in the contiguous United States south of Alaska; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 160 cfs (115,835 A.F./yr)

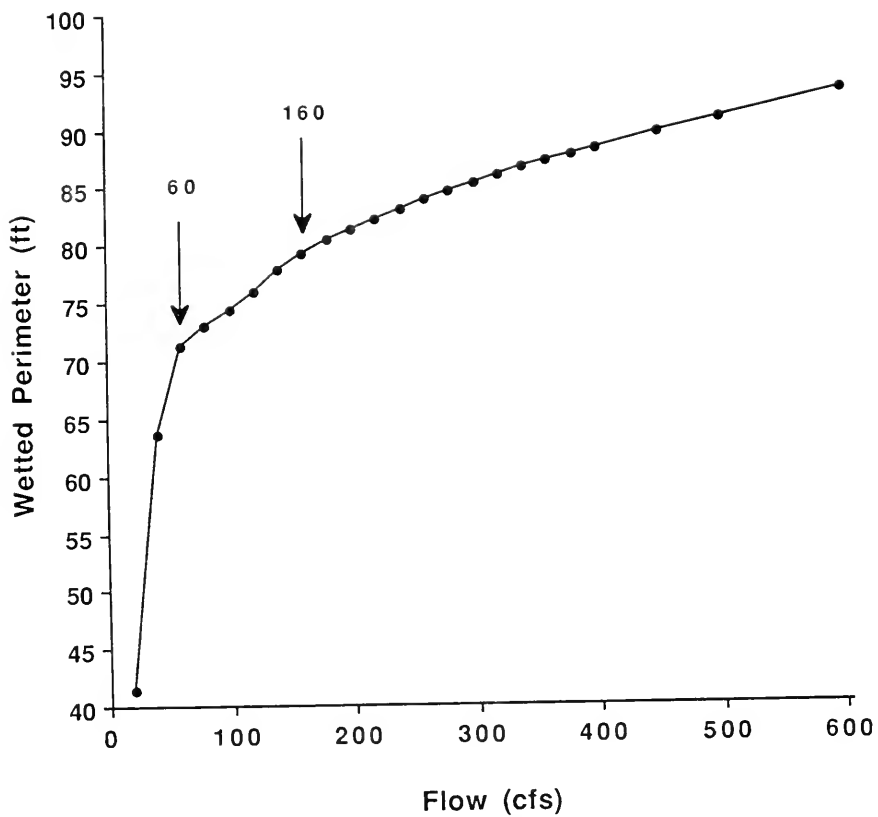


Figure 2-50. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Reach #1 of the Big Hole River.

STREAM NAME: Big Hole River

STREAM REACH: #2. From the confluence of Pintlar Creek to the old Divide Dam - 41.7 miles

LOCATION: Sec. 8, T1S, R14W to Sec. 11, T1S, R10W

DESCRIPTION OF STREAM REACH:

Reach #2 of the Big Hole River is 41.7 river miles in length. Between Dewey and the site of the old Divide Dam, the river flows for about 3 miles through a narrow, steep canyon. Upstream, it flows through meadow lands adjacent to conifer covered hillsides. Cottonwoods nearly disappear from the riparian zone with the increase in altitude. Willows are the most important plant providing streambank stability and overhanging cover for fish along this reach. Major tributaries include Deep, LaMarche and Fishtrap Creeks, which drain the Anaconda Pintlar Range to the north, and the Wise River, which drains the Pioneer Mountains to the south.

The average gradient of Reach #2 is approximately 1.9 ft per 1,000 ft. Stream width varies with location and flow, but generally is in excess of 100 ft and may exceed 250 ft in places at high flows. At low flow, Reach #2 at its lower end averages about 185 ft in width. The bottom substrate generally consists of gravel and cobble interspersed with finer particles in the depositional zones.

Dewatering during the irrigation season represents the greatest threat to the fishery and aquatic resource of Reach #2. Additional problems include the trampling of streambanks by wintering cattle, which decreases bank stability, increases sedimentation and, in turn, can lead to the widening of the river channel.

Sediment loads are generally not a problem in Reach #2. However, cattle wintering in the river bottom and the existence of a large feedlot operation extending into the river present localized problem areas. Logging activities in tributary drainages of the Big Hole have the potential for increasing sediment loads.

The USGS operated a gage in Reach #2 (river mile 63) from September, 1910 through September, 1913. This gage is located 7.3 miles upstream from the downstream boundary of Reach #2. The mean annual flow for the three complete years of record was 1,377 cfs.

GAME FISH PRESENT: Mountain whitefish, rainbow trout, brown trout, arctic grayling, brook trout.

FISHERY:

In 1978 an electrofishing survey was conducted in a 26,400 ft section of Reach #2 (Wells and Rehwinkel, 1980). Game fish captured in descending order of abundance were mountain whitefish, rainbow trout, arctic grayling, brown trout and brook trout. Mottled sculpin, longnose dace, burbot and longnose, mountain and white suckers were the other species present. Table 2-47 summarizes the survey data for 1978.

Table 2-47. Summary of electrofishing survey data collected for a 26,400 ft section of Reach #2 (T1N, R12W, Sec. 3B to 13C) of the Big Hole River in September and October, 1978.

Fish Species	Number Captured	Length Range (inches)
Mountain whitefish	1,205	2.0 - 19.9
Rainbow trout	79	7.2 - 23.9
Arctic grayling	19	8.5 - 13.5
Brown trout	8	12.7 - 27.0
Brook trout	3	10.0 - 11.1

Although the number of rainbow trout captured in the study section was low, the population is characterized by the presence of large, trophy-size fish. Low numbers of large brown trout were also present.

In September, 1986, a trout population estimate was obtained for a 4.7 mile section of river between the Jerry Creek Bridge and Dewey, near the downstream boundary of Reach #2. The section supported an estimated 1,366 rainbow trout from 6.0-22.3 inches, weighing a total of 689 pounds, per mile of river. One hundred eighty-three brown trout from 9.0-25.6 inches, weighing 316 pounds, were estimated per mile, giving a total trout biomass of 1,005 pounds. Small numbers of grayling and brook trout were also found in the section, along with an abundance of mountain whitefish. Future population increases are expected following the implementation, in 1988, of special angling regulations for the lower 18 miles of Reach #2.

WILDLIFE:

Lands along Reach #2 provide good winter range for moose and also winter some mule deer and elk. Beaver, mink, marten and mountain lion also inhabit adjacent lands. Bobcats and coyotes frequent the river banks and ospreys and bald eagles are observed seasonally. Reach #2 is used by breeding ducks and as a resting stop for spring and fall migrating waterfowl. Waterfowl hunting is popular during the fall season.

WETTED PERIMETER:

Cross-sectional measurements were made in a 412 ft section of Reach #2 (Sec. 36B, T1N, R11W) located about 7 miles upstream from the old Divide Dam, the downstream boundary of the reach. The WETP program was calibrated to field data collected at flows of 367, 466, 468 and 812 cfs.

The wetted perimeter-flow relationship for the composite of five riffle cross-sections (Figure 2-51) shows a prominent upper inflection point at a flow of about 800 cfs.

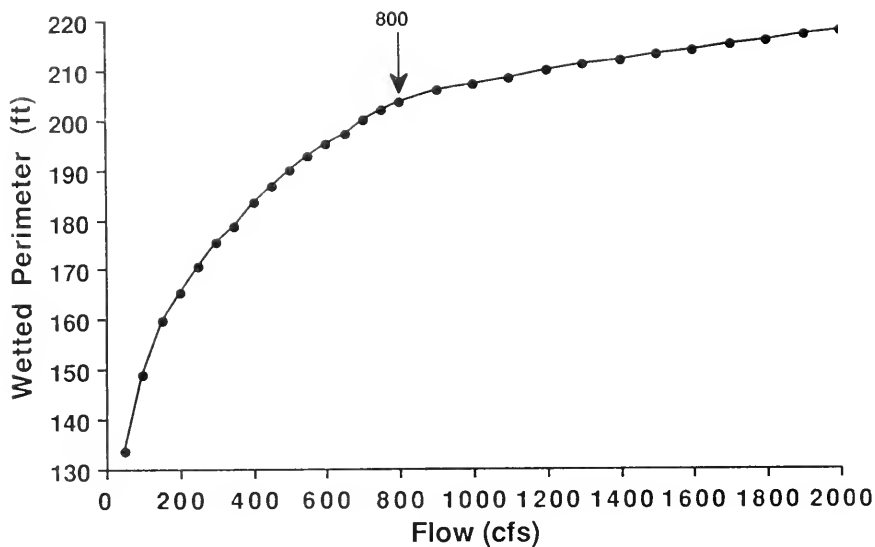


Figure 2-51. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Reach #2 of the Big Hole River.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to help maintain crucial habitat for the only major fluvial arctic grayling population remaining in the United States south of Alaska; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 800 cfs (579,173 A.F./yr)

STREAM NAME: Big Hole River

STREAM REACH: #3. From the old Divide Dam to the mouth - 55.8 miles

LOCATION: Sec. 11, T1S, R10W to Sec. 21, T3S, R6W

DESCRIPTION OF STREAM REACH:

This "Blue Ribbon" reach of the Big Hole River is 55.8 miles long. The river in the upper 16 miles of Reach #3 passes through a narrow canyon, while the lower 30 miles primarily meander through cottonwood lined banks within the lower Big Hole valley. In many places, the lower river breaks up into more than one channel, creating islands. The riparian zone of the floodplain is vegetated with cottonwood, willow, rose and other deciduous shrubs. All of these are important in providing streambank stability and overhanging cover for fish.

The river substrate is generally of a gravel to cobble nature. Finer materials are found in deposition areas such as the inside of bends and pools.

The average gradient from the Divide Dam site to the mouth is approximately 14 ft per river mile. Stream width varies with location and flow, but is generally in excess of 125 ft and may exceed 225 ft in places at high flow.

Dewatering during the irrigation season represents the most severe threat to the fishery of Reach #3. Irrigators have the capability to almost totally dewater the lower portion of Reach #3 during low water years. Any additional depletions during the low flow period would have a severe impact on the aquatic resource of this reach.

The USGS has operated a gage at river mile 31 of Reach #3 since 1923. The mean annual flow for a 56-year period of record was 1,160 cfs. Mean monthly flows of record ranged from 351 cfs (for January) to 4,100 cfs (for June). Water to irrigate about 136,000 acres is diverted above this site. Flows at this gage reflect the severe dewatering that can occur during the summer irrigation season.

GAME FISH PRESENT: Mountain whitefish, brown trout, rainbow trout, brook trout, arctic grayling, cutthroat trout.

FISHERY:

In the 1960's, the MDFWP began estimating the standing crops of trout in various sections of Reach #3 of the Big Hole River using electrofishing procedures. The highest trout populations in the river are presently found in a 17-mile-long section of reach #3 (between river miles 39 and 56) being managed with special angling regulations designed to increase the number of larger trout. In the fall of 1983, this section supported an estimated 2,174 age II (about 10 inches and longer) brown and rainbow trout, weighing 2,583 pounds, per river mile. The brown trout predominated, comprising about 50% of the trout numbers and 65% of the biomass. Populations of larger brown

trout (18 inches +) and rainbow trout (15 inches +) have increased dramatically since the implementation of special regulations in 1981.

In the lower portion of Reach #3, brown trout predominate, while rainbow trout are uncommon. A population estimate made in a 15,000 ft section of the Big Hole near its mouth in September, 1979 showed 449 pounds of brown trout per mile. The population decline in the lower river reflects the severe dewatering that occurs during most irrigation seasons. Although the entire reach is affected by summer irrigation depletions, the impact appears most severe in the lower river.

The mountain whitefish is the most numerous game fish in Reach #3. Whitefish provide an unexploited winter fishery for their enthusiasts. A state record whitefish (4.46 pounds) was captured in Reach #3 during electrofishing work in the fall of 1978. Grayling and brook trout are found in very low numbers in Reach #3, while cutthroat trout are extremely rare. Other species present include burbot, carp, longnose dace, mottled sculpin, white sucker, mountain sucker and longnose sucker.

In general, the trout fishery of Reach #3 of the Big Hole River, although impacted by summer dewatering, is a healthy one characterized by the presence of large numbers of 16 inch and longer trout in comparison to most other rivers in Montana.

During the 1977 and 1978 fishing seasons, a 10-mile stretch of Reach #3 between Melrose and Glen was studied to determine fishermen use and harvest (Kozakiewicz, 1979). An estimated 5,397 and 3,987 anglers fished this section in 1977 and 1978, respectively. A total of 1,088 boats used the study area during these two years. Anglers harvested 3,974 trout in 1977 and 2,746 trout in 1978.

WILDLIFE:

Lands along the lower Big Hole River below the old Divide Dam provide winter range for mule deer, elk and moose. An excellent white-tailed deer population is present year-round and, in the canyon at Maiden Rock, bighorn sheep reside. The beaver is the primary resident furbearer along this stretch. Other inhabitants include mink, muskrat, river otter, bobcat and coyote. A few ring-necked pheasants, turkeys and Hungarian partridge inhabit lands along the lower river.

Reach #3 is used extensively by breeding ducks and geese and as a resting stop for spring and fall migrating waterfowl. Canadian goose production is limited to islands in the river and nesting success is dependent upon flows sufficient to provide security from predators. Reach #3 provides considerable waterfowl hunting opportunities.

WETTED PERIMETER:

Cross-sectional measurements were made in a 268 ft section of Reach #3 near the river's mouth (Sec. 29A, T3S, R6W). Four riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 55, 543 and 1,450 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-52. Lower and upper inflection points occur at about 260 and 650 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid population, which includes low numbers of fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 650 cfs (470,578 A.F./yr)

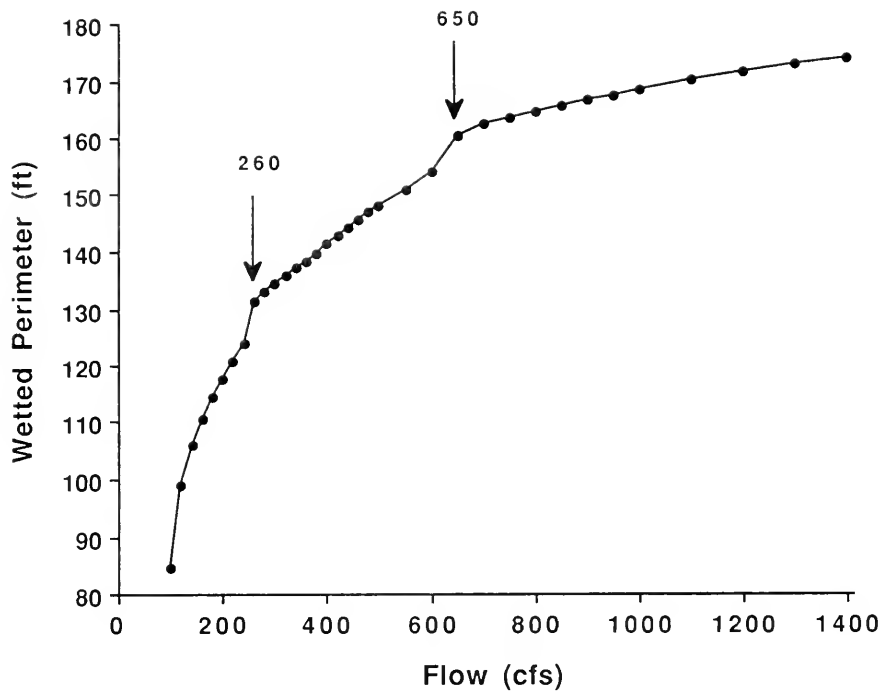


Figure 2-52. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Reach #3 of the Big Hole River.

STREAM NAME: South Fork Big Hole River

STREAM REACH: From Skinner Lake to the mouth - 17 miles

LOCATION: Sec. 1, T8S, R16W to Sec. 26, T5S, R15W

DESCRIPTION OF STREAM REACH:

The South Fork Big Hole River originates at Skinner Lake along the eastern slope of the Continental Divide and flows in a northerly direction for 17 miles before converging with Warm Springs Creek near the town of Jackson to form the Big Hole River. The meandering channel passes through numerous beaver ponds and is densely lined with willows. The stream drains grassland/sagebrush benches along its lower reaches and dense lodgepole forests in its upper portion. Seventy-six percent of the 78.5 square mile drainage is controlled by the USFS, while the remaining 24% is privately owned. Much of the South Fork passes through private lands. Tributaries to the South Fork Big Hole River include Pioneer, Darkhorse, Berry, Jahnke and Saginaw Creeks. The average gradient of the 25 ft wide channel is 13 ft per 1,000 ft.

Lands within the South Fork Big Hole drainage are used for recreation, cattle grazing, hay production and, historically, mining. An improved gravel road parallels and crosses the stream, allowing good access for hunting, camping and fishing. Because of an extensive trail system, fishing and camping on the numerous alpine lakes in the drainage can be enjoyed.

The grazing of cattle occurs throughout the South Fork Big Hole Valley on public and private lands. Grazing within the riparian zone along portions of the lower and middle stretches of stream has resulted in bank trampling, loss of overhanging vegetative cover, mass wasting and minor erosion. Loss of riparian habitat has also resulted from the physical and chemical removal of willows to increase grazing area and provide access to water.

The major land use on private lands within the lower drainage is hay production. These hay lands are irrigated with water from the South Fork Big Hole River. As a result, the South Fork is entirely diverted into a series of irrigation ditches.

From 1948 to 1953, the USGS operated a gage at stream mile 11.3 of the South Fork Big Hole River approximately one mile above the USFS boundary. The average annual flow for the three complete years of record was 52.1 cfs. Mean monthly flows ranged from 9.5 cfs (for January) to 226 cfs (for June). This site is upstream from all irrigation diversions.

GAME FISH PRESENT: Brook trout, rainbow trout, mountain whitefish, burbot.

FISHERY:

A 1,300 ft section of the South Fork Big Hole River was electrofished on July 31 and August 6 and 27, 1980. Game fish present in descending order of abundance were brook trout, rainbow trout, mountain whitefish and burbot. Longnose sucker and mottled sculpin were the only non-game species captured (Table 2-48).

Table 2-48. Summary of electrofishing survey data collected for a 1,300 ft section of the South Fork Big Hole River (T7S, R15W, Sec. 8A) on July 21 and August 6 and 27, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	319	3.6 - 10.7
Rainbow trout	6	5.3 - 12.0
Mountain whitefish	5	12.1 - 15.0
Burbot	2	15.1 - 15.3
Mottled sculpin	-	-
Longnose sucker	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-49). The stream supported about 443 brook trout 5.0 inches and longer, weighing 64 pounds, per 1,000 ft. This is approximately seven fish per pound, which is above average for streams surveyed in the Beaverhead National Forest. The South Fork Big Hole River supports one of the highest populations of brook trout within the Big Hole drainage.

Table 2-49. Estimated standing crop of brook trout in a 1,300 ft section of the South Fork Big Hole River (T7S, R15W, Sec. 8A) on July 31, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	115	
	6.0 - 9.9	311	
	10.0 - 10.7	<u>17</u>	
		443(±82)	64(±12)

WILDLIFE:

The South Fork drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 184 ft riffle-pool sequence located in T7S, R15W, Sec. 8A. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 21.2, 150.5 and 306.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-53. Lower and upper inflection points occur at about 10 and 22 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 22 cfs (15,927 A.F./yr)

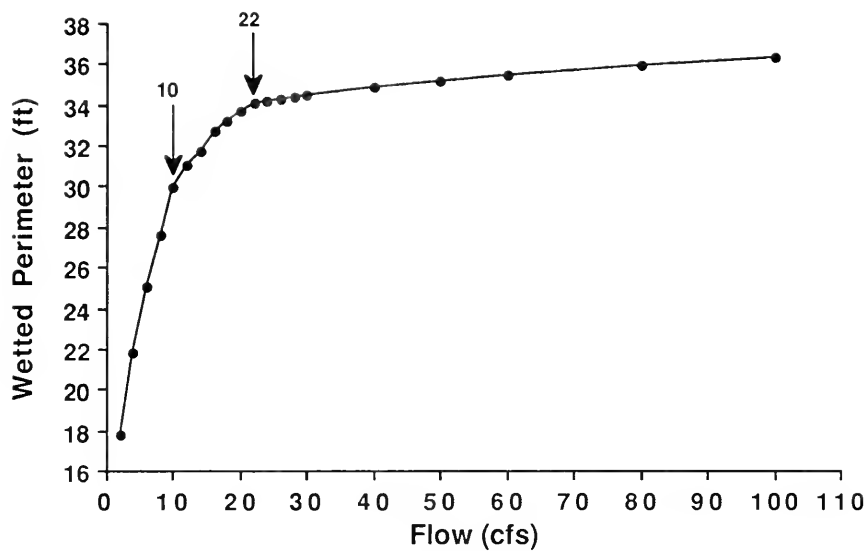


Figure 2-53. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the South Fork Big Hole River.

STREAM NAME: Governor Creek

STREAM REACH: From the headwaters to the mouth - 18 miles

LOCATION: Sec. 32, T7S, R14W to Sec. 26, T5S, R15W

DESCRIPTION OF STREAM REACH:

Governor Creek originates along the Big Hole Divide, a small chain of mountains stemming from the Bitterroot Mountains of southwest Montana. It flows in a northerly direction for about 18 miles before joining Warm Springs Creek, a tributary to the Big Hole River. The average gradient of the 32 ft wide channel is 17 ft/1,000 ft. The drainage primarily consists of open grassland/sagebrush hillsides. Much of this land has been converted into irrigated hay pastures. The riparian zone is vegetated with willow, grasses and forbs. Ownership of the 122 square mile drainage is shared by private individuals (56%), the USFS (42%) and the State of Montana (7%). Fifteen of the 18 miles of stream channel are on private lands. Access to the majority of the drainage is provided by gravel country roads. Major tributaries include Andrus, Fox and Pine Creeks.

Lands within the Governor Creek drainage are used primarily for hay production and cattle grazing. The stream is diverted into numerous irrigation ditches along its course and can be severely dewatered in its lower 12 miles during the irrigation season. Along lower Governor Creek, the trampling and grazing of the banks by cattle have caused a loss of stream vegetative cover and undercut banks, have increased soil erosion and widened the channel. This abuse, coupled with flow decreases during the irrigation season, has increased sedimentation in important riffle and pool habitats. Willows along portions of the lower stream have been removed physically or chemically to increase grazing area.

GAME FISH PRESENT: Brook trout, mountain whitefish, burbot, rainbow trout, cutthroat trout, arctic grayling.

FISHERY:

A 1,000 ft section of Governor Creek located up and downstream from the bridge on Miner Creek Road was electrofished on July 24 and August 8, 1979. Game fish captured in descending order of abundance were brook trout, mountain whitefish, burbot, rainbow trout and arctic grayling. Longnose sucker, longnose dace and mottled sculpin were the non-game species present (Table 2-50).

Table 2-50. Summary of electrofishing survey data collected for a 1,000 ft section of Governor Creek (T5S, R15W, Sec. 26C and 35B) on July 24 and August 8, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	54	2.9 - 12.8
Mountain whitefish	28	3.0 - 10.8
Burbot	10	7.2 - 11.3
Rainbow trout	3	5.0 - 6.2
Arctic grayling	2	7.7 - 8.7
Longnose sucker	-	-
Longnose dace	-	-
Mottled sculpin	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-51). This 1,000 ft section supported about 130 brook trout 5.0 inches and longer, weighing 29 pounds. Populations of other game fish were too sparse to estimate using the mark-recapture method.

Table 2-51. Estimated standing crop of brook trout in a 1,000 ft section of Governor Creek (T5S, R15W, Sec. 26C and 35B) on July 24, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	18	
	6.0 - 9.9	99	
	10.0 - 12.8	13	
		130(±161)	29(±13)

Brad Shepard, fishery biologist on the Beaverhead National Forest, found a higher density of brook trout upstream (in T7S, R14W, Sec. 6D) from the site of the above estimate. He estimated 57 (±11 at an 80% CI) brook trout under 6.0 inches and 155 (±5 at an 80% CI) brook trout 6.0 inches and longer, weighing a total of 42 pounds, per 1,000 ft of stream. Shepard also electrofished a 325 ft section of upper Governor Creek (in T7S, R14W, Sec. 32B) and captured nine Salmo which appeared to be westslope cutthroat trout. The genetic purity of these fish has to be confirmed by electrophoretic analysis.

In 1978 and 1979, Liknes (1981) captured arctic grayling fry in Governor Creek north of the Miner Creek Road and larger arctic grayling at three locations in the lower five miles. Governor Creek was one of only four streams to contain fry as well as older arctic grayling. The fluvial arctic grayling is classified as a species of "special concern" in Montana. Once widely distributed throughout the upper Missouri River drainage, remnant populations of the fluvial form are now found only in the upper Big Hole River drainage. It is imperative that instream flow protection is secured for those streams still supporting arctic grayling populations.

WILDLIFE:

The Governor Creek drainage supports moose year-round and seasonal populations of elk and mule deer from spring through fall. The drainage also supports a good black bear population. Other wildlife present include lynx and marten. Blue and spruce grouse are the primary game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected for a 72 ft riffle-pool sequence near the mouth of Governor Creek (T5S, R15W, Sec. 36C). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 8.0 and 35.8 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-54. Lower and upper inflection points occur at 2 and 4 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations, which may include westslope cutthroat trout, a species of "special concern" in Montana; to protect crucial habitat for the fluvial arctic grayling, another species of "special concern"; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4 cfs (2,896 A.F./yr)

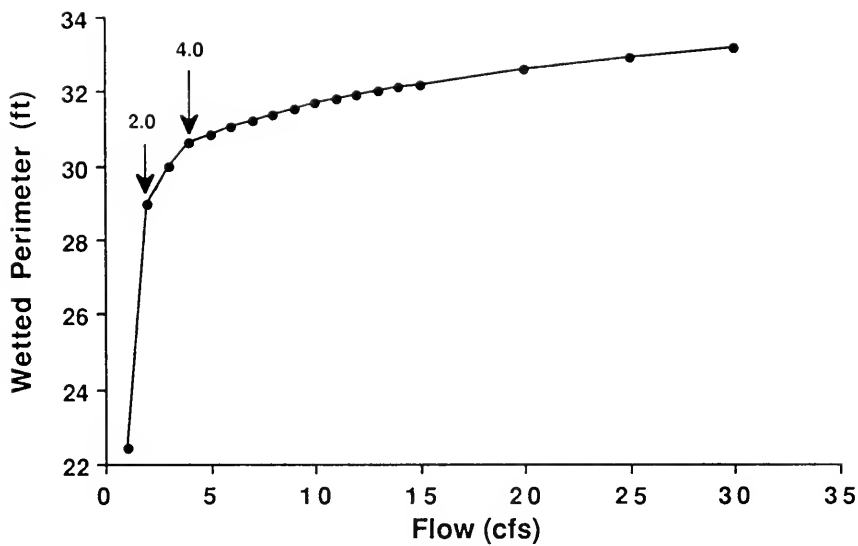


Figure 2-54. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Governor Creek.

STREAM NAME: Warm Springs Creek

STREAM REACH: From the confluence of the West and East Forks to the mouth-
18.1 miles

LOCATION: Sec. 2, T4S, R14W to Sec. 26, T5S, R15W

DESCRIPTION OF STREAM REACH:

The West and East Forks of Warm Springs Creek originate in wet meadows on the western slope of the Pioneer Mountains of southwest Montana. Upon converging, Warm Springs Creek is formed and flows 18.1 miles in a south-westerly direction before joining the South Fork of the Big Hole River near the town of Jackson to form the Big Hole River. The stream is characterized by a densely willowed riparian zone containing numerous beaver dams. The stream drains grassland/sagebrush hillsides having scattered stands of aspens and conifers. The gradient of the 25 ft wide channel averages 12 ft/1,000 ft. Major tributaries to Warm Springs Creek include Governor, Bear, Cox, Old Tim and Little Milk Creeks. The 95 square mile drainage is controlled by the USFS (87%), private individuals (12%) and the BLM (1%).

Land uses in the Warm Springs drainage are varied. They include recreation, cattle grazing, hay production, timber harvesting and limited amounts of mining and mineral exploration. Recreational activities consist of hunting, fishing, hiking and camping. Warm Springs Creek is one of the more heavily used recreational fisheries in the Big Hole drainage. Unimproved roads and trails border the entire stream, allowing access to the numerous alpine lakes, meadows and rugged peaks of the upper drainage. Presently, the upper roadless portion of the drainage is being considered for inclusion into the National Wilderness System. The harvesting of salvage timber, the development of molybdenum and other mineral resources and road construction are being proposed for the roadless portion of the drainage.

Agricultural uses within the drainage consist of cattle grazing on public and private lands and hay production along the lower reaches. Stretches of the riparian zone have been severely impacted by cattle. Diversion of the lower reaches for irrigation leaves the natural channel severely dewatered during the summer months.

The SCS (Farnes and Schafer, 1975) estimated the mean annual water yield for the Warm Springs drainage at 58,400 acre-feet (80.7 cfs).

CAME FISH PRESENT: Brook trout, burbot.

FISHERY:

A 1,000 ft section of Warm Springs Creek was electrofished on July 25 and August 8, 1979. Ninety brook trout from 2.2-11.2 inches were captured. Other species present were burbot (10 captured), longnose sucker (2 captured), longnose dace and mottled sculpin.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-52). This 1,000 ft section supported an estimated 256 brook trout 4.0 inches and longer, weighing 43 pounds. Although the majority of

the population exceeded seven inches, their condition (length to weight ratio) was below average for tributaries to the Big Hole River.

Table 2-52. Estimated standing crop of brook trout in a 1,000 ft section of Warm Springs Creek (T5S, R14W, Sec. 16C) on July 25, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	108	
	6.0 - 9.9	128	
	10.0 - 11.2	20	
		256(±139)	43(±23)

WILDLIFE:

The Warm Springs Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 177 ft riffle-pool sequence of Warm Springs Creek located in T5S, R14W, Sec. 16C. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 14.8 and 86.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-55. Lower and upper inflection points occur at about 5 and 20 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 20 cfs (14,479 A.F./yr)

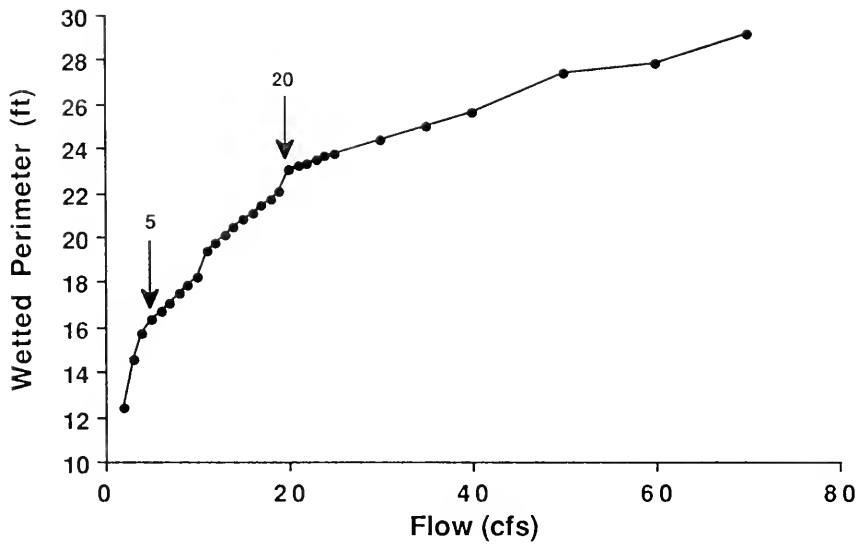


Figure 2-55. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Warm Springs Creek.

STREAM NAME: Miner Creek

STREAM REACH: From Upper Miner Lakes to the mouth - 18 miles

LOCATION: Sec. 34, T6S, R17W to Sec. 3, T5S, R15W

DESCRIPTION OF STREAM REACH:

Miner Creek originates at Upper Miner Lakes in the Bitterroot Mountains of southwest Montana and flows for about 6.5 miles in a northeasterly direction before entering Lower Miner Lakes from which it flows an additional 11.5 miles before discharging into the Big Hole River. Steep, timbered slopes characterize the headwater area, while grassland/sagebrush hillsides surround the lower stream. Much of the lower drainage has been converted to irrigated hay pastures. Ownership of the 27 square mile drainage is shared by the USFS (74%), private landowners (24%) and the State of Montana (2%). In its lower reaches, the stream splits into two channels as it passes through private lands. The average gradient of the 35 ft wide main channel is 29 ft/1,000 ft.

Lands within the Miner Creek drainage are primarily used for livestock grazing, hay production and recreation in the form of fishing, hunting, camping and hiking. There are two USFS campgrounds along the stream and hiking trails lead to primitive camping sites in the Upper Miner Lakes area. Access is provided by a gravel road paralleling the stream for all but its upper 2.5 miles. The roadless portion of the drainage is presently being considered for inclusion into the National Wilderness System.

Livestock grazing in the riparian zone along portions of the Miner Creek drainage has caused damage to fishery habitat through the trampling of banks and the reduction of vegetative stream cover. The diversion of natural flows from the stream for irrigation, coupled with increased erosion and bank instability, have caused sediment to deposit in riffle and spawning areas within the lower reaches.

From 1948-1953, the USGS operated a gage at stream mile 9.0 of Miner Creek upstream from all irrigation diversions. The mean annual flow for the three complete years of record (1949-51 water years) was 33.8 cfs. Mean monthly flows ranged from 6.3 cfs (for January) to 122 cfs (for June).

GAME FISH PRESENT: Brook trout, burbot, arctic grayling.

FISHERY:

Two 1,000 ft sections of Miner Creek below the Lower Miner Lakes were electrofished on July 24, 1979 and August 27, 1980. Due to the clarity of the water, its low specific conductance and the morphology of the channel, the electrofishing gear used was ineffective in capturing fish. Thus, the numbers of fish captured do not reflect the magnitude of the populations in Miner Creek. Game species collected were brook trout and burbot. Longnose sucker and mottled sculpin were the only non-game species present. Table 2-53 combines the electrofishing results for the two sections. Due to the low numbers of fish captured, a population estimate using a mark-recapture method was not possible.

Table 2-53. Summary of electrofishing survey data collected for two 1,000 ft sections of Miner Creek (T6S, R16W, Sec. 3C and Sec. 9A) on July 24, 1979 and August 17, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	28	2.8 - 8.6
Burbot	1	5.9
Longnose sucker	2	8.2 - 10.0
Mottled sculpin	-	-

Liknes (1981) captured arctic grayling in sections of Miner Creek above the Lower Miner Lakes. This species is classified as a species of "special concern" in Montana. Once widely distributed throughout the upper Missouri River drainage, the fluvial form is presently found only in remnant populations in the upper Big Hole River drainage. For streams that still support arctic grayling, it is imperative that instream flow protection is secured.

WILDLIFE:

The Miner Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 203 ft section of Miner Creek about 1.5 miles above the USFS boundary (T6S, R16W, Sec. 3C). Five cross-sections describing the meandering habitat were established. To calibrate the WETP program, field data were collected at flows of 13.1 and 99.1 cfs.

The relationship between wetted perimeter and flow for a single riffle-like cross-section is shown in Figure 2-56. Lower and upper inflection points occur at about 4 and 9 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect critical habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 9 cfs (6,516 A.F./yr)

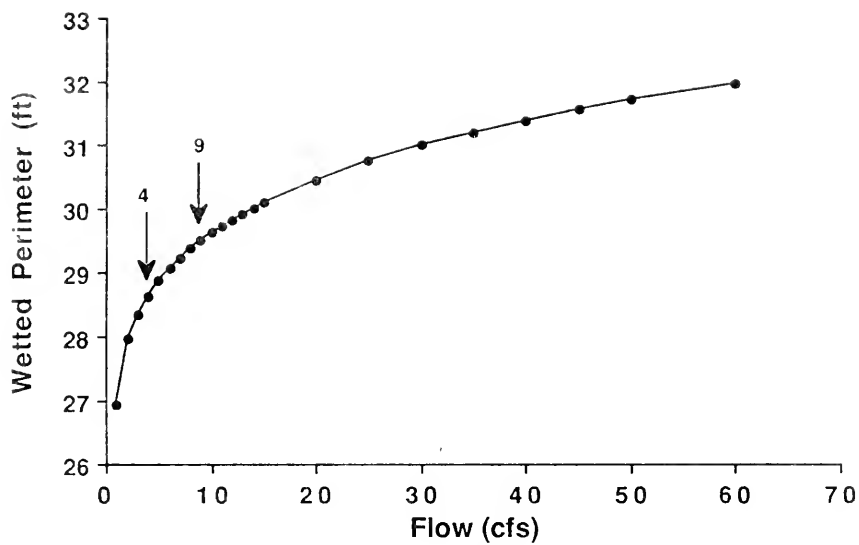


Figure 2-56. The relationship between wetted perimeter and flow for a single riffle cross-section in Miner Creek.

STREAM NAME: Rock Creek

STREAM REACH: From the Beaverhead National Forest boundary to the mouth - 14 miles

LOCATION: Sec. 24, T4S, R17W to Sec. 8, T3S, R15W

DESCRIPTION OF STREAM REACH:

Rock Creek originates at the Continental Divide in forested mountain lands of the Beaverhead National Forest and flows for over 20 miles before converging with Big Lake Creek, a tributary to the Big Hole River. Throughout much of its lower 14 miles, Rock Creek meanders through open, flat hay and pasture lands owned primarily by private individuals. BLM and State parcels comprise a small portion of the remaining lands. The low gradient channel of the lower 14 miles frequently disappears into a vast network of flooded beaver ponds, particularly at its downstream end, and swampy wetlands. The channel substrate is comprised of gravel, silt and some sand. Willow cover along portions of the reach is heavy.

Irrigation diversions typically dewater portions of the lower stream in late summer. Over-use by livestock has damaged the banks along sections of the reach.

GAME FISH PRESENT: Brook trout, mountain whitefish, arctic grayling.

FISHERY:

A 400 ft sample section of Rock Creek in Sec. 19 CC, T3S, R15W was electrofished on August 27, 1985. In one electrofishing pass, 13 arctic grayling from 3.5-7.4 inches in length were captured. Other fish present were brook trout, mountain whitefish, longnose sucker and longnose dace.

On May 3, 1988, the lower portion of Rock Creek upstream from its mouth at Big Lake Creek (Sec. 8 CC, T3S, R15W) was electrofished in search of spawning arctic grayling. Thirteen grayling were captured, 10 of which were mature, ripe adults in spawning condition. Immature grayling were again captured upstream in Sec. 19.

It appears that the extreme lower portion of Rock Creek provides spawning habitat for arctic grayling, while the entire lower creek, at least from Sec. 19 downstream, provides yearlong rearing habitat for grayling juveniles.

WILDLIFE:

The mountain headwater area of Rock Creek drainage provides good summer range for elk, mule deer and moose. Moose winter in the willow bottoms along lower Rock Creek. Good populations of black bear and marten inhabit the drainage's mountain forests along with a few wolverine and lynx. Blue and spruce grouse are the primary game birds within the drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important spawning and rearing habitats for stream-dwelling arctic grayling, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5.0 cfs (3,620 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Rock Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier in Volume 1. Under this method, 32% of the average annual flow is being requested for those Big Hole River tributaries having high fishery values. An average annual flow of 15.7 cfs was estimated by the USGS for Rock Creek. An instream flow of 5.0 cfs is, therefore, requested.

STREAM NAME: Big Lake Creek

STREAM REACH: From the Twin Lakes outlet to the mouth - 24.2 miles

LOCATION: Sec. 10, T5S, R17W to Sec. 33, T2S, R15W

DESCRIPTION OF STREAM REACH:

Big Lake Creek originates in the Beaverhead Mountains at the Continental Divide and flows approximately three miles before entering Twin Lakes. From the Twin Lakes outlet the creek flows for 24.2 miles northeast before entering the Big Hole River near the town of Wisdom. It drains an area of approximately 96 square miles. The upper 8 miles of Big Lake Creek flow through forested lands within the Beaverhead National Forest, while the lower 16 miles primarily pass through private grazing and agricultural lands within the Big Hole valley.

GAME FISH PRESENT: Brook trout, burbot, mountain whitefish, rainbow trout, arctic grayling.

FISHERY:

Three sections of Big Lake Creek located about 4, 5 and 18 miles upstream from the confluence with the Big Hole River were electrofished in 1985 and 1986. Section lengths were 1,550, 1,000 and 350 ft, respectively. The lower two sections passed through a sparsely vegetated valley bottom, had a channel gradient under 0.5% and a streambed comprised of cobble, gravel, sand and silt. The upper section flowed through coniferous forest and had a moderate gradient, a streambed of boulder, cobble and gravel and accumulations of woody debris in the channel.

Species captured in the lower two sections in descending order of abundance were brook trout, burbot, mountain whitefish and arctic grayling. The brook trout was the only game fish present in the upper section. Population estimates were not made in any of the study sections.

Arctic grayling utilize the lower portion of Big Lake Creek for rearing and spawning as age 0 fry were captured in the lower study section. Lower Big Lake Creek is one of a few sites in the Big Hole drainage having a documented concentration of spawning grayling. Rainbow trout spawning was documented in the lower portion of the creek in 1987, with nine redds observed in about 1.3 miles of stream.

WILDLIFE:

The Big Lake Creek drainage supports moose year-round and mule deer and elk from spring through fall. Other inhabitants of importance include white-tailed deer, black bear, bobcat, mountain lion and Franklin's grouse.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid population, which includes the fluvial arctic grayling - a species of "special concern" in Montana; to protect spawning and rearing habitats for

rainbow trout and arctic grayling residing in the Big Hole River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4.7 cfs (3,403 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Big Lake Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 32% of the average annual flow is being requested for those Big Hole River tributaries having high fishery values. An average annual flow of 14.6 cfs was estimated by the USGS for Big Lake Creek. An instream flow of 4.7 cfs is, therefore, requested.

STREAM NAME: Francis Creek

STREAM REACH: From the confluence of Sand Creek to the mouth - 5.3 miles

LOCATION: Sec. 23, T3S, R15W to Sec. 3, T3S, R15W

DESCRIPTION OF STREAM REACH:

Francis Creek drains the western benches and steeper, upper slopes of the West Pioneer Mountains of southwest Montana. It flows in a westerly direction for about 8 miles before entering Steel Creek, a tributary to the Big Hole River. The drainage is comprised of grassland/sagebrush benches along the lower reaches and steep, timbered slopes in the headwater area. Except for two small improved roads, the drainage is roadless. Sand and Sheep Creeks are the only perennial tributaries to Francis Creek. Ownership of the 25 square mile drainage is shared by the USFS (60%), private individuals (20%) and the State of Montana (20%). Average gradient of this 22 ft wide stream is 32 ft per 1,000 ft.

Major land uses within the Francis Creek drainage are cattle grazing and hay production in the lower drainage and grazing and recreation on USFS lands. Recreational activities include hunting, fishing and hiking. Presently, the entire USFS portion of the drainage is under consideration for inclusion with the National Wilderness System.

The long-term use of the riparian zone of Francis Creek by cattle has adversely affected stretches of the stream. Overuse by cows has led to minor erosion of the stream banks, the widening of the channel due to trampling and the reduction of bank cover due to the over-browsing of streamside willows. Sediments produced along these stretches have deposited in the slower pool areas and deeper runs.

GAME FISH PRESENT: Brook trout, burbot, mountain whitefish, arctic grayling.

FISHERY:

A 1,000 ft section of Francis Creek was electrofished on July 18 and August 7, 1979. Game fish captured in descending order of abundance were brook trout, burbot, mountain whitefish and arctic grayling. Non-game species present were longnose and white sucker and mottled sculpin (Table 2-54).

Table 2-54. Summary of electrofishing survey data collected for a 1,000 ft section of Francis Creek (T3S, R15W, Sec. 3B) on July 18 and August 7, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	413	1.6 - 14.0
Burbot	32	4.8 - 9.0
Mountain whitefish	7	2.9 - 6.4
Arctic grayling	1	8.3
Longnose sucker	197	2.6 - 11.1
White sucker	2	11.6 - 12.4
Mottled sculpin	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-55). This 1,000 ft section supported about 758 brook trout 4.0 inches and longer, weighing 111 pounds. Francis Creek contained the second highest brook trout population of the streams sampled in the Beaverhead National Forest. Although the population is high, the fish are not stunted and have a good length to weight ratio.

Table 2-55. Estimated standing crop of brook trout in a 1,000 ft section of Francis Creek (T3S, R15W, Sec. 3B) on July 18, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	259	
	6.0 - 9.9	462	
	10.0 - 14.0	37	
		758(±171)	111(±20)

Francis Creek supports low numbers of fluvial (stream-dwelling) arctic grayling, a species of "special concern" in Montana. Once abundant throughout the upper Missouri River drainage above the Great Falls, fluvial grayling now exist in only remnant populations in the upper Big Hole drainage. It is imperative that instream flow protection is secured for those streams still supporting arctic grayling.

WILDLIFE:

The Francis Creek drainage supports antelope from spring through fall. In winter, it provides important winter range for many migrating elk. In summer, resident elk inhabit the drainage. Other resident wildlife include black bear, bobcat and marten. Blue and spruce grouse are the upland game birds in the basin.

WETTED PERIMETER:

Cross-sectional data for Francis Creek were collected for a 67 ft riffle-pool sequence in T3S, R15W, Sec. 3B. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 3.7 and 63.1 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-57. Lower and upper inflection points occur at about 1 and 4 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect important habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4 cfs (2,896 A.F./yr)

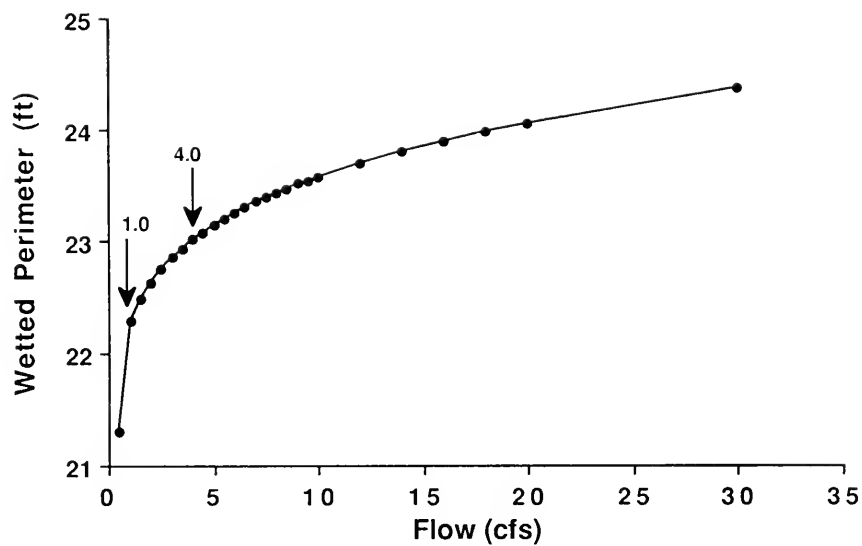


Figure 2-57. The relationship between wetted perimeter and flow for a single riffle cross-section in Francis Creek.

STREAM NAME: Steel Creek

STREAM REACH: From the headwaters to the mouth - 12.0 miles

LOCATION: Sec. 2, T3S, R14W to Sec. 27, T2S, R15W

DESCRIPTION OF STREAM REACH:

Steel Creek originates in the West Pioneer Mountains of southwest Montana. The stream flows in a westerly direction for 12.0 miles before entering the Big Hole River one mile north of Wisdom. Topographic and vegetative characteristics of the upper and lower reaches of the drainage differ considerably. Upper Steel Creek cascades through heavily timbered, steep slopes. The bottom substrate consists of cobble and boulder. The lower reaches meander through willow-lined and open banks surrounded by grassland/sagebrush benches. The channel has a finer bottom substrate. Average gradient of the 20 ft wide channel is 43 ft/1,000 ft. Major tributaries include Wisconsin, Francis, Stanley and the South Fork Steel Creeks. Ownership of the 80.5 square mile drainage is shared by the USFS (42%), private individuals (35%), the State of Montana (21%) and the BLM (1%).

Lands within the Steel Creek drainage are used for recreation, cattle grazing, hay production and a limited amount of mining. Recreational activities include fishing, hunting, camping and hiking. An extensive trail system leads to numerous alpine lakes. An improved gravel road parallels the stream, ending at a USFS campground. The headwater area is presently being considered for inclusion into the National Wilderness System. Molybdenum mining and the harvesting of salvageable timber may occur in the headwater area if wilderness protection is not secured.

Cattle grazing occurs on private and public lands within the Steel Creek drainage. Damage to the riparian zone by overgrazing and trampling is evident along some stretches of the stream. Physical removal of the streambank willows has also occurred along a mile section of private land. Hay production is a major activity along the lower reaches of the stream. Water from Steel Creek is diverted during the summer irrigation months, causing some dewatering. Increased erosion rates coupled with flow reductions have caused sediment to accumulate in riffles and slower pools.

GAME FISH PRESENT: Brook trout, mountain whitefish, burbot, arctic grayling.

FISHERY:

A 1,000 ft section of Steel Creek was electrofished on July 18 and August 6, 1979. Game fish present in descending order of abundance were brook trout, mountain whitefish, burbot and arctic grayling. Longnose sucker, longnose dace and mottled sculpin were the non-game species present (Table 2-56).

Table 2-56. Summary of electrofishing survey data collected for a 1,000 ft section of Steel Creek (T2S, R15W, Sec. 34A) on July 18 and August 6, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	462	1.2 - 14.7
Mountain whitefish	9	3.1 - 5.8
Burbot	3	6.1 - 12.0
Arctic grayling	2	7.4 - 12.6
Longnose sucker	-	-
Longnose dace	-	-
Mottled sculpin	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-57). This 1,000 ft section supported a population of 1,183 brook trout 4.0 inches and longer, weighing a total of 150 pounds. This is the highest standing crop of brook trout found in 50 streams surveyed in the Big Hole, Beaverhead and Red Rock drainages. The largest brook trout captured was 14.7 inches and weighed 1.6 pounds. The condition factor (length to weight ratio) was well above average for all length groups.

Table 2-57. Estimated standing crop of trout in a 1,000 ft section of Steel Creek (T2S, R15W, Sec. 34A) on July 18, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	646	
	6.0 - 9.9	490	
	10.0 - 14.7	47	
		1,183(±291)	150(±34)

Liknes (1981) found arctic grayling fry and older individuals in the lower reaches of Steel Creek. This indicates reproduction by a resident population or use of this tributary by the main river population as a spawning area. The fluvial arctic grayling is classified as a species of "special concern" in Montana. Once widely distributed throughout the upper Missouri River drainage, the grayling is now only found in remnant populations in the upper Big Hole drainage. It is imperative that instream flow protection is secured for those streams still supporting grayling populations.

WILDLIFE:

The Steel Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

A 55 ft section of Steel Creek (T3S, R14W, Sec. 4C) was selected for the collection of cross-sectional data. Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 3.2 and 21.0 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-58. Lower and upper inflection points occur at about 2 and 6 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect critical habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 6 cfs (4,344 A.F./yr)

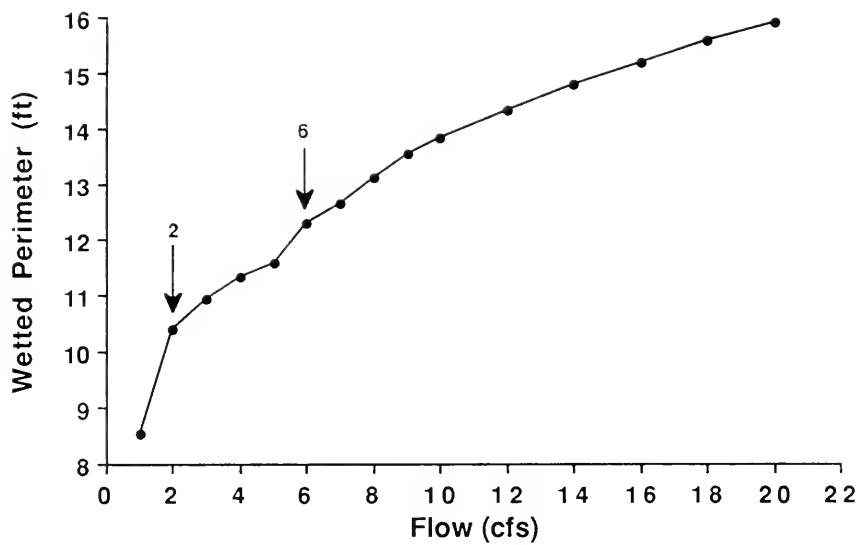


Figure 2-58. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Steel Creek.

STREAM NAME: Swamp Creek

STREAM REACH: From Yank Swamp to the mouth - 19.4 miles

LOCATION: Sec. 27, T3S, R17W to Sec. 9, T2S, R15W

DESCRIPTION OF STREAM REACH:

Swamp Creek originates in Yank Swamp, a 5.5 mile long marsh located on the eastern slope of the Bitterroot Mountain Range. Swamp Creek flows for about 20 miles in a northeasterly direction before converging with the Big Hole River, 3.5 miles north of Wisdom. The 85 square mile drainage consists primarily of sagebrush/grassland benches. Much of this land has been converted to irrigated hay pastures. Only Moose Creek, its major tributary, drains moderately timbered slopes. Land ownership of the drainage is shared by private interests (76%), the USFS (19%), the State of Montana (3%) and the BLM (2%). The 30 ft wide channel has a gradient of 8 ft per 1,000 ft.

Lands within the Swamp Creek drainage are primarily used for cattle grazing and hay production. Recreation in the form of hiking and fishing also occurs. A series of gravel roads provide access throughout the drainage.

Upon leaving the USFS land, the waters of Swamp Creek are diverted into an extensive irrigation system with ditches connecting adjacent drainages. Swamp Creek is severely dewatered throughout its course. The majority of Swamp Creek enters the Big Hole River through irrigation return.

Grazing within the riparian zone and the physical removal of stream bordering willows have resulted in increased erosion, trampled banks and the loss of undercut banks and overhanging vegetative cover. Sedimentation within riffle and spawning areas is extensive. Riprapping of banks to prevent bank erosion and channel movement has occurred at several sites along the stream.

GAME FISH PRESENT: Brook trout, burbot, mountain whitefish, arctic grayling.

FISHERY:

A 1,000 ft section of Swamp Creek located near the mouth was electro-fished on July 13 and August 6, 1979. Game fish present in descending order of abundance were brook trout, burbot and mountain whitefish. Longnose sucker, longnose dace and mottled sculpin was the non-game species captured (Table 2-58).

Table 2-58. Summary of electrofishing survey data collected for a 1,000 ft section of Swamp Creek (T2S, R15W, Sec. 8A) on July 13 and August 6, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	78	2.0 - 13.9
Burbot	30	3.1 - 11.2
Mountain whitefish	4	2.5 - 3.3
Longnose sucker	-	-
Longnose dace	-	-
Mottled sculpin	-	-

A population estimate could not be obtained for Swamp Creek due to the low number of recaptured trout. Of the 78 brook trout captured, 54% were less than 4 inches. The severe dewatering that occurs throughout the Swamp Creek drainage is probably impacting trout standing crops.

Liknes (1981) captured fry as well as larger arctic grayling in the lower reaches of Swamp Creek, identifying this stream as spawning habitat for this species. Although older arctic grayling were found, it is unknown whether these individuals were residents or returned to the main river when habitat conditions deteriorated during the irrigation season.

Brad Shepard, fishery biology on the Beaverhead National Forest, has also documented the presence of arctic grayling in Swamp Creek. On August 22, 1985 two arctic grayling, measuring 4.4 and 9.8 inches, were captured while electrofishing a 500 ft stream section in T2S, R15W, Sec. 16C. Two additional grayling measuring 12.6 and 13.4 inches were captured on May 18, 1986 in a downstream trap located near the mouth of Swamp Creek.

WILDLIFE:

The Swamp Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

A 300 ft section of Swamp Creek near the mouth (T2S, R15W, Sec. 8A) was selected for the collection of cross-sectional data. The riffle-run habitat within the section was described using five cross-sections. The WETP program was calibrated to field data collected at flows of 7.6 and 74.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-59. Lower and upper inflection points occur at about 4 and 8 cfs, respectively.

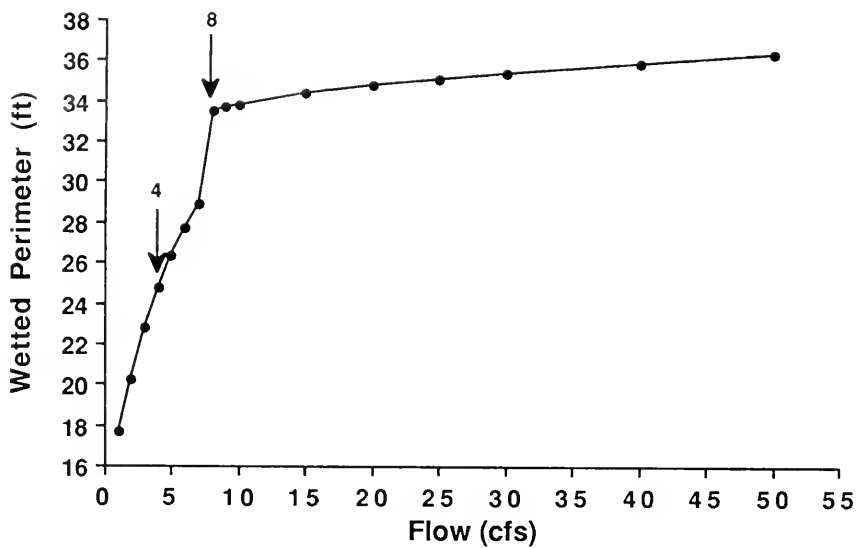


Figure 2-59. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Swamp Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect crucial habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 8 cfs (5,792 A.F./yr)

STREAM NAME: Joseph Creek

STREAM REACH: From the confluence of Anderson Creek to the mouth - 5.6 miles

LOCATION: Sec. 11, T2S, R19W to Sec. 15, T2S, R18W

DESCRIPTION OF STREAM REACH:

Joseph Creek originates on the east slope of the Bitterroot Mountains of southwest Montana and flows in an easterly direction for about 6 miles before joining Trail Creek, a tributary to the North Fork of the Big Hole River. The USFS controls 99% of the 13.5 square mile drainage, with the remainder belonging to private individuals. Much of the stream is surrounded by steep, timbered slopes. A dense cover of willows lines the lower reaches. Beaver ponds are also prevalent. Average gradient of the 18 ft wide channel is 26 ft/1,000 ft. The bottom substrate is composed of sand, gravel and cobble. Major perennial tributaries include Anderson, Richardson and Cabinet Creeks.

Lands within the Joseph Creek drainage are used for cattle grazing and recreation in the form of hunting and fishing. Hunting pressure for moose and elk is moderate within the drainage.

Highway 43 parallels the stream throughout most of its length, crossing the channel at four locations. Habitat losses have occurred above and below these bridges with impacts on stream cover and sinuosity.

GAME FISH PRESENT: Brook trout, burbot.

FISHERY:

A 1,000 ft section of Joseph Creek at stream mile 1.0 was electrofished on July 19 and August 10, 1979. One hundred two brook trout, ranging from 2.0-11.1 inches, and 13 burbot from 4.8-9.1 inches were captured. The mottled sculpin was the only non-game species captured.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-59). This 1,000 ft section of Joseph Creek supported about 137 brook trout, weighing 14 pounds. For a mountain stream of its size, Joseph Creek supports a good brook trout fishery.

Table 2-59. Estimated standing crop of brook trout in a 1,000 ft section of Joseph Creek (T2S, R18W, Sec. 16A) on July 19, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	89	
	6.0 - 9.9	47	
	10.0 - 11.1	1	
		137(±25)	14(±3)

WILDLIFE:

The Joseph Creek drainage supports moose year-round and seasonal populations of elk and mule deer from spring through fall. The drainage also supports a good black bear population. Other wildlife present include lynx and marten. Blue and spruce grouse are the primary game birds within the drainage.

WETTED PERIMETER:

A 105 ft section of Joseph Creek near stream mile 0.7 (T2S, R18W, Sec. 16A) was selected for the collection of cross-sectional data. Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 3.5, 14.6 and 35.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-60. Lower and upper inflection points occur at about 0.8 and 5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

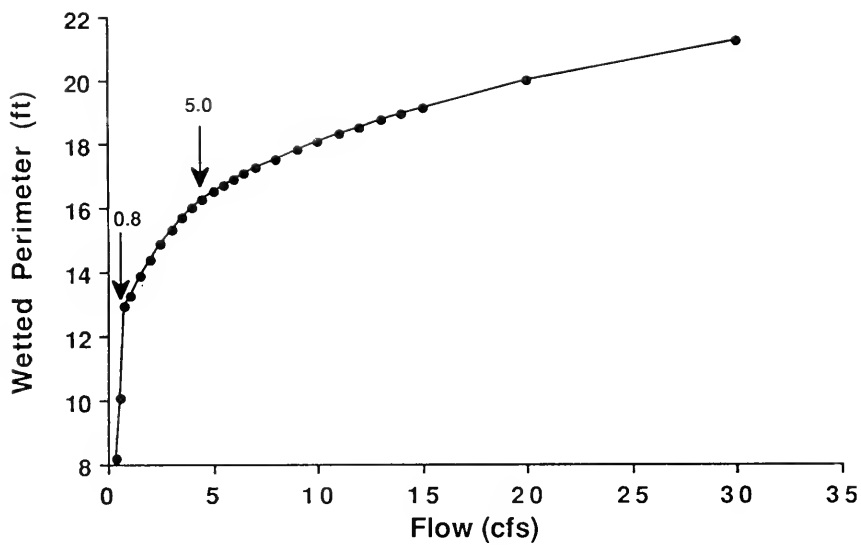


Figure 2-60. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Joseph Creek.

STREAM NAME: Trail Creek

STREAM REACH: From the headwaters to the mouth - 23 miles

LOCATION: Sec. 7, T1S, R18W to Sec. 24, T2S, R17W

DESCRIPTION OF STREAM REACH:

Trail Creek originates in the Bitterroot Mountains of southwest Montana. It flows in an easterly direction for about 23 miles before converging with Ruby Creek to form the North Fork Big Hole River. The majority of the 81 square mile basin is controlled by the USFS (98%). The remaining 2% is divided equally between private landowners and the National Park Service (Big Hole Battlefield National Monument). Joseph, May, Elk, Hogan and Prairie Creeks are among the 19 tributaries to Trail Creek. The Trail Creek drainage in its upper reaches is characterized by steep, timbered slopes and a narrow floodplain. In its lower reaches, the stream meanders through dense willows and numerous beaver ponds. The stream has an average gradient of 11 ft/1,000 ft. The channel averages 20-28 ft in width.

Lands within the Trail Creek drainage are used for cattle grazing, timber harvesting, and recreation in the form of fishing, hunting and camping. Montana Highway 43 parallels and crosses the lower 9 miles of stream. Various gravel roads allow access to the remainder of the drainage. A USFS campground and recreational cabin are located along the creek.

Historically, Trail Creek and several of its tributaries were extensively placer mined and dredged for gold. The main stem from the headwaters to approximately 7 miles above the mouth was worked in the late 1800's and early 1900's.

The USGS operated a gage on lower Trail Creek at stream mile 4.9 between 1948 and 1971. The mean annual flow for the 8-year period of record was 85.3 cfs. Mean monthly flows ranged from 15 cfs (for January, February and March) to 410 cfs (for May). There were no diversions above this site.

GAME FISH PRESENT: Brook trout, mountain whitefish, burbot, rainbow trout.

FISHERY:

A 1,000 ft section of Trail Creek at about stream mile 5.4 was electrofished on July 19 and August 10, 1979. On August 6, 1980 this section was extended to 1,500 ft and again electrofished. Game fish present were brook trout, mountain whitefish and burbot. Mottled sculpin, longnose sucker and longnose dace were the non-game species captured. Table 2-60 summarizes the 1979 and 1980 electrofishing data. The population of game fish was too sparse to estimate using the mark-recapture method.

Table 2-60. Summary of electrofishing survey data collected for a 1,000 ft section of Trail Creek (T2S, R17W, Sec. 22C) on July 19 and August 10, 1979 and a 1,500 ft section (T2S, R17W, Sec. 22C) on August 6, 1980.

Fish Species	Number Captured		Length Range (inches)	
	<u>1979</u>	<u>1980</u>	<u>1979</u>	<u>1980</u>
Brook trout	15	10	2.3 - 10.3	3.0 - 8.3
Mountain whitefish	13	3	7.2 - 15.6	9.8 - 12.1
Burbot	17	3	5.2 - 13.5	6.5 - 9.9
Mottled sculpin	-	-	-	-
Longnose dace	-	-	-	-
Longnose sucker	-	-	-	-

Although the physical characteristics of the channel appeared suitable for trout, the population is severely depressed. Causes are unknown, although mine pollution and excessive sedimentation are suspected.

Three 300 ft sections of Trail Creek were electrofished by Heaton (1960) in 1959 (Table 2-61). The sections were approximately located at stream mile 10, 3 and 0.25. A substantial decrease in brook trout numbers occurred between miles 10 and 3. The cause of the decline is again unknown.

Table 2-61. Summary of electrofishing survey data collected for three 300 ft sections of Trail Creek in 1959. Length ranges in inches are in parentheses.

Stream Mile	Brook Trout	Rainbow Trout	Mountain Whitefish	Burbot	Longnose Sucker
10	88 (2.1-8.9)	-	-	-	-
3	24 (2.4-7.8)	1 (3.6)	-	1	-
0.25	22 (2.6-12.8)	-	6 (3.6-12.4)	51	-

Brad Shepard, fishery biologist on the Beaverhead National Forest, obtained population estimates for two sections of Trail Creek. The study section at stream mile 2 (T2S, R17W, Sec. 22D) supported about 6.5 pounds of

brook trout per 1,000 ft, while the section at stream mile 17 (T1S, R18W, Sec. 31A) supported an estimated 17 pounds per 1,000 ft. The headwater portion of Trail Creek supports a far greater biomass of trout than does the lower stream.

WILDLIFE:

The Trail Creek drainage supports moose year-round and seasonal populations of elk and mule deer from spring through fall. The drainage also supports a good black bear population. Other wildlife present include lynx and marten. Blue and spruce grouse are the primary game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 69 ft section of Trail Creek near stream mile 2.0 (T2S, R17W, Sec. 22C). Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 17.8 and 108.1 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-61. Lower and upper inflection points occur at about 6 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

The fishery of lower Trail Creek does not justify a flow recommendation at the upper inflection point. Mine pollution in combination with excessive instream sedimentation are probably responsible for the depressed fishery in the lower stream. If these problems are corrected in the future, the fishery of Trail Creek could improve substantially. For this reason, the high inflection point flow (14 cfs) is requested. Should reclamation occur, a 14 cfs reservation would help insure that the flow is sufficient to accommodate a potentially expanding trout population.

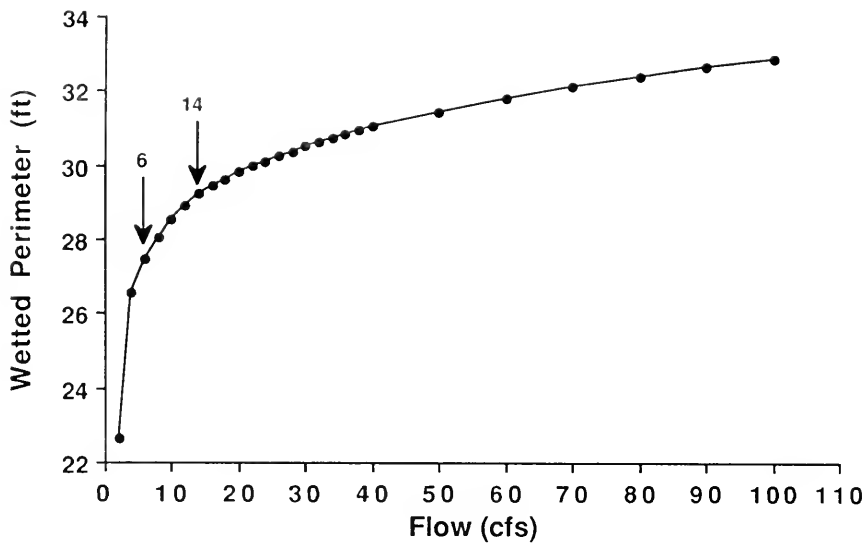


Figure 2-61. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Trail Creek.

STREAM NAME: Ruby Creek

STREAM REACH: From the confluence of Pioneer and West Fork Ruby Creeks to the mouth - 15.0 miles

LOCATION: Sec. 25, T3S, R18W to Sec. 24, T2S, R17W

DESCRIPTION OF STREAM REACH:

Ruby Creek originates on the eastern slope of the Bitterroot Mountains in southwest Montana. The stream is formed at the convergence of the West Fork Ruby Creek and Pioneer Creek and flows in a northeasterly direction for 15 miles before joining Trail Creek to form the North Fork Big Hole River. The 18 ft wide channel has a moderate gradient of 9 ft/1,000 ft. Much of the stream meanders through dense willows and beaver ponds. Only the headwater area and upper 4 miles drain forested lands. The remainder of the drainage is in an open grassland/sagebrush valley. Ninety-one percent of the 54.5 square mile drainage is controlled by the USFS. The remaining 9% is privately owned. Approximately half the stream length is located on private land.

Lands within the Ruby Creek drainage are used for recreation, cattle grazing, hay production, timber harvesting and mining. Recreational uses include fishing, hunting and backpacking. An extensive pack trail system traverses the headwater area. Several gravel roads within the drainage provide excellent access to the stream and many of its tributaries.

The logging of lodgepole pine is a continuing use in the drainage. The latest sale began in the summer of 1979. Cattle grazing occurs on private as well as public lands. Improper management of these activities could lead to increased sediment loads and loss of riparian habitat. Hay fields throughout the lower drainage are irrigated with water diverted from Ruby Creek, causing severe dewatering of the natural channel. Much of the water of Ruby Creek enters the North Fork Big Hole River as subsurface irrigation returns.

Historically, placer gold mining occurred in the headwater tributaries of Ruby Creek, but the production was never large. Since the fall of 1980, gold exploration has occurred throughout the upper drainage.

GAME FISH PRESENT: Brook trout, rainbow x cutthroat hybrid trout, burbot.

FISHERY:

A 1,000 ft section of Ruby Creek approximately 2.5 miles above the USFS boundary was electrofished on July 20 and August 7, 1979. Brook trout, rainbow x cutthroat hybrids and burbot were the game fish captured. Non-game species present were mottled sculpin and longnose sucker (Table 2-62).

Table 2-62. Summary of electrofishing survey data collected for a 1,000 ft section of Ruby Creek (T3S, R17W, Sec. 20D) on July 20 and August 7, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	229	2.0 - 10.3
Burbot	3	5.2 - 12.1
Rainbow x cutthroat hybrid trout	2	6.2 - 6.5
Longnose sucker	2	4.1 - 4.8
Mottled sculpin	-	-

The standing crop of brook trout in the section was estimated using a mark-recapture method (Table 2-63). This 1,000 ft section supported about 505 brook trout 4.0 inches and longer, weighing 52 pounds. Ruby Creek supported one of the highest populations of brook trout within the streams electrofished in the Big Hole drainage.

Table 2-63. Estimated standing crop of brook trout in a 1,000 ft section of Ruby Creek (T3S, R17W, Sec. 20D) on July 20, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	237	
	6.0 - 9.9	266	
	10.0 - 10.3	2	
		505(±101)	52(±11)

WILDLIFE:

The Ruby Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected for a 53 ft section of Ruby Creek located approximately 2.5 miles above the USFS boundary (T3S, R17W, Sec. 20D). Five cross-sections defining the riffle-pool habitat were

established. The WETP program was calibrated to field data collected at flows of 5.3 and 30.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-62. Lower and upper inflection points occur at about 1.2 and 4.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4.0 cfs (2,896 A.F./yr)

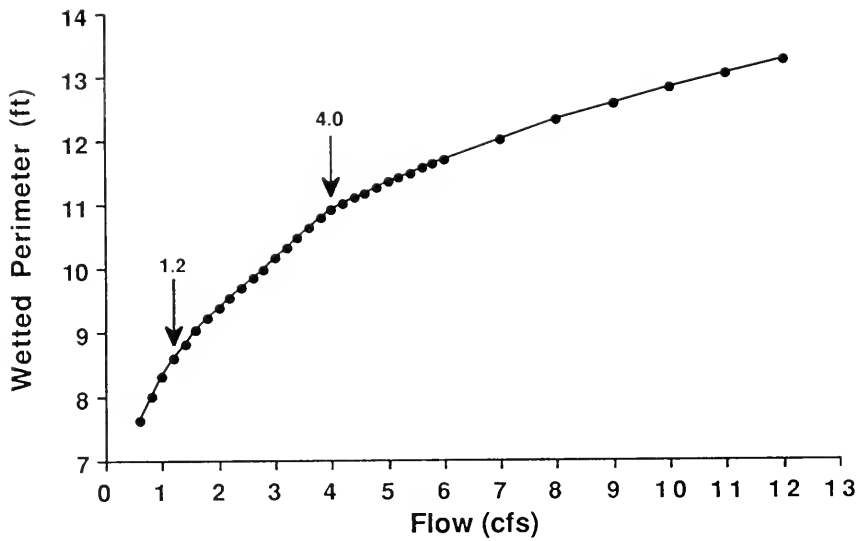


Figure 2-62. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Ruby Creek.

STREAM NAME: Johnson Creek

STREAM REACH: From the confluence of Schultz Creek to the Forest Service boundary - 7 miles

LOCATION: Sec. 8, T1S, R1W to Sec. 25, T1S, R1W

DESCRIPTION OF STREAM REACH:

Johnson Creek originates in the Anaconda-Pintlar Range of southwest Montana and flows in a southeasterly direction for about 15 miles before entering the North Fork of the Big Hole River. The drainage is characterized by steep, timbered slopes in the upper reaches and grassland/sagebrush benches in the lower reaches. The 41.5 square mile drainage is controlled by the USFS (82%), private individuals (18%) and the BLM (1%). Average gradient of the 15 ft wide channel is 30 ft/1,000 ft. The riparian zone is vegetated with alder, birch and grasses in the upper drainage and dense willow stands in the lower drainage. Major tributaries to Johnson Creek include Schultz, Addition and Bender Creeks.

Logging and road construction have been extensive in the upper portion of the Johnson Creek drainage. Lands within the lower drainage are used for cattle grazing and hay production. Recreational activities, including fishing and hunting, occur throughout the area. During the hunting season, the drainage is moderately hunted for mule deer and elk.

Logging activity in the upper drainage has resulted in the loss of riparian habitat, an increased sediment load and channel alterations. Downstream from the USFS boundary, Johnson Creek is entirely diverted into a series of irrigation ditches.

GAME FISH PRESENT: Brook trout, burbot, mountain whitefish.

FISHERY:

A 1,000 ft section of Johnson Creek was electrofished on July 26, 1979. Due to access problems, only one electrofishing pass was completed. Game fish present in descending order of abundance were brook trout, burbot and mountain whitefish. The total weight of the 125 brook trout captured was 15.3 pounds. Forty-four (35%) of these were seven inches and longer. Table 2-64 summarizes the electrofishing survey data.

Table 2-64. Summary of electrofishing survey data collected for a 1,000 ft section of Johnson Creek (T1S, R16W, Sec. 30B) on July 26, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	125	2.2 - 10.4
Burbot	12	6.3 - 11.0
Mountain whitefish	2	11.1 - 11.2
Longnose sucker	7	5.0 - 10.7
Mottled sculpin	-	-
Longnose dace	-	-

Brad Shepard, fishery biologist on the Beaverhead National Forest, obtained population estimates for two sections of Johnson Creek in 1986. The upper section (in T1S, R17W, Sec. 5C) contained an estimated 130 (± 14 at an 80% CI) brook trout from 3.0 to 5.9 inches and 27 (± 2 at an 80% CI) brook trout 6.0 inches and longer per 1,000 ft of stream. The lower site (T1S, R17W, Sec. 25A) supported an estimated 69 (± 2 at an 80% CI) brook trout from 3.0 to 5.9 inches and 52 (± 2 at an 80% CI) brook trout 6.0 inches and longer per 1,000 feet of stream. Johnson Creek supports a substantial brook trout fishery for a mountain stream of its size.

WILDLIFE:

From spring through fall, the Johnson Creek drainage supports mule deer, white-tailed deer, elk, moose, black bear and mountain lion. In winter, important range for deer and elk and critical range for moose are provided. Furbearers present include mink, marten, beaver, Canada lynx and bobcat. Bobcats, in particular, are abundant. Blue and spruce grouse are the primary upland game birds inhabiting the drainage.

WETTED PERIMETER:

Cross-sectional data were collected for a 90 ft riffle-run sequence located approximately 0.5 above the USFS boundary (T1S, R17W, Sec. 24C). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 5.4 and 56.4 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section is shown in Figure 2-63. Lower and upper inflection points occur at about 5 and 13 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 13 cfs (9,412 A.F./yr)

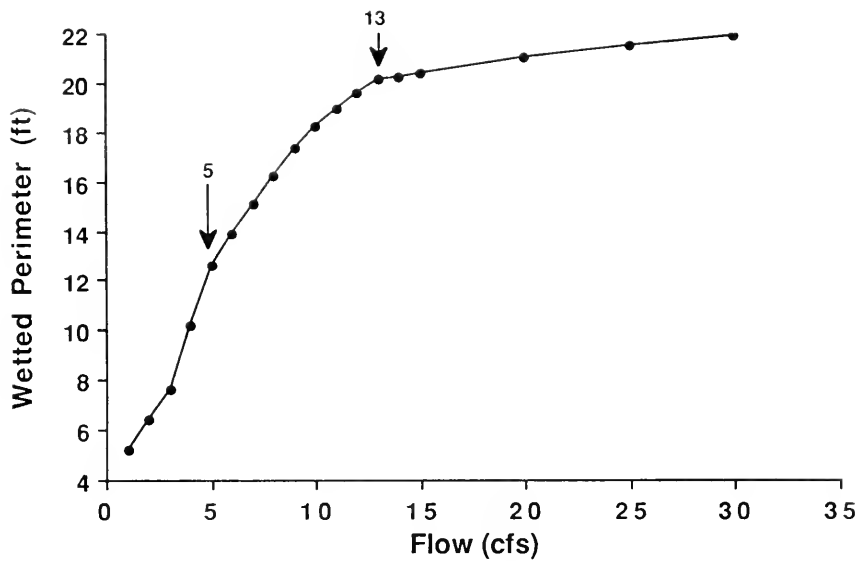


Figure 2-63. The relationship between wetted perimeter and flow for a single riffle cross-section in Johnson Creek.

STREAM NAME: Mussigbrod Creek

STREAM REACH: From the confluence of Hell Roaring Creek to the Forest Service boundary - 4.1 miles

LOCATION: Sec. 30, T1N, R16W to Sec. 9, T1S, R16W

DESCRIPTION OF STREAM REACH:

Mussigbrod Creek originates in the Anaconda-Pintlar Range of southwest Montana and flows in an easterly direction for about 5 miles before entering Mussigbrod Lake. From the lake outlet the stream flows an additional 9.4 miles before joining the North Fork Big Hole River. Hell Roaring Creek is the only named tributary in the 29.5 square mile drainage. Lands within the drainage are controlled by the USFS (66%), private landowners (32%) and the State of Montana (2%). Eighteen percent of the USFS land is within the Anaconda-Pintlar Wilderness Area. The upper channel flows through steep, heavily timbered slopes. Upon crossing the USFS boundary, the stream meanders through willow bottoms surrounded by grassland/sagebrush benches. Average gradient of the 21 ft wide channel is 25 ft/1,000 ft.

Land uses within the Mussigbrod Creek drainage include recreation in the form of hunting, fishing and camping, cattle grazing, hay production and timber harvesting. Cattle are grazed throughout the drainage and hay production occurs on private lands along the lower reaches. A gravel road ends at the USFS campground located on Mussigbrod Lake. Pack trails continue into the upper reaches of the drainage to Surprise and Violet Lakes.

Although Mussigbrod Lake is a natural lake, a dam has been constructed on its outlet for irrigation purposes. Storage of irrigation water during the fall and winter months results in the dewatering of the stream. During the summer irrigation season, the flow of lower Mussigbrod Creek is entirely diverted into a series of ditches.

GAME FISH PRESENT: Brook trout, burbot, arctic grayling.

FISHERY:

A 1,000 ft section of Mussigbrod Creek above the USFS boundary and below Mussigbrod Lake was electrofished on July 13 and August 9, 1979. One hundred seven brook trout, ranging from 1.8-11.2 inches, and 4 burbot from 9.2-13.4 inches were captured. Other species present were longnose sucker (one captured) and mottled sculpin.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-65). This 1,000 ft section supported about 251 brook trout 4.0 inches and longer, weighing a total of 27 pounds. The majority of the fish present were less than 10 inches and averaged 9 fish per pound. Heaton (1960) believed that the closing of the dam on Mussigbrod Lake in fall and winter and the resulting downstream dewatering depressed the trout fishery of the creek.

Table 2-65. Estimated standing crop of brook trout in a 1,000 ft section of Mussigbrod Creek (T1S, R16W, Sec. 9B) on July 13, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	143	
	6.0 - 9.9	105	
	10.0 - 11.2	3	
		251(±118)	27(±13)

In 1979, Liknes (1981) captured 12 arctic grayling, ranging in length from 5.7-9.0 inches, in a section of Mussigbrod Creek below Mussigbrod Lake. The lake is recognized as having one of the best lacustrine (lake-dwelling) arctic grayling populations remaining in the upper Big Hole drainage. The grayling inhabiting the creek are likely drifters from the lake, although low numbers of the stream-dwelling (fluvial) form - a species of "special concern" in Montana - may also be present.

WILDLIFE:

The Mussigbrod Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional information was collected in a 49 ft riffle-pool sequence located in T1S, R16W, Sec. 9B. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 4.3 and 71.8 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-64. Lower and upper inflection points occur at about 3 and 10 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect habitat for arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

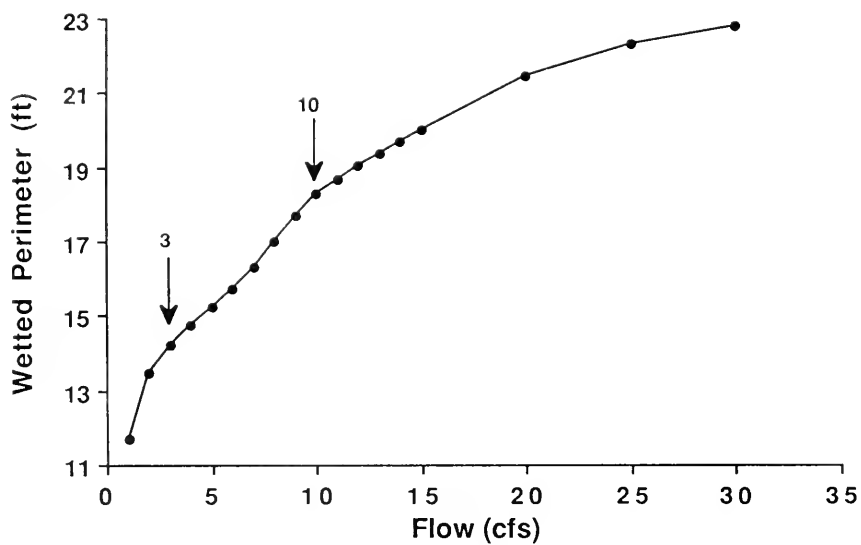


Figure 2-64. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Mussigbrod Creek.

STREAM NAME: North Fork Big Hole River

STREAM REACH: From the junction of Ruby and Trail Creeks to the mouth - 25.3 miles

LOCATION: Sec. 24, T2S, R17W to Sec. 26, T1S, R15W

DESCRIPTION OF STREAM REACH:

North Fork Big Hole River originates at the junction of Ruby and Trail Creeks and flows in a northeasterly direction for 25.3 miles before entering the Big Hole River near the town of Wisdom, Montana. The North Fork flows through a broad sagebrush/grassland valley. Much of the floodplain has been converted to irrigated hay pastures. Only the upper reaches of its tributaries drain steeply forested slopes and high alpine meadows. Although the entire length of the channel flows through private land, only 20% of the 270 square mile drainage is owned by private individuals. The remainder of the drainage is managed by the USFS (78%), State of Montana (1%) and BLM (1%). The riparian zone is vegetated with forbs, grasses and dense willows. In addition to Ruby and Trail Creeks, other major tributaries include Johnson, Tie and Mussigbrod Creeks. The average gradient of the 43 foot wide channel is approximately 3 ft/1,000 ft.

Lands with the North Fork Big Hole drainage are used for recreation in the form of hunting, fishing and hiking, cattle grazing, irrigated wild hay production, logging along the upper reaches of tributaries and, historically, mining. Access to the North Fork is provided by several unimproved roads paralleling the stream for the majority of its length.

Cattle grazing and related land use activities have damaged the riparian zone along stretches of the North Fork. Willows along the lower two miles of stream were removed chemically in 1978 by the aerial spraying of 2-4D. Flow from the North Fork is diverted to irrigate wild hay fields, causing severe dewatering of the channel during the summer growing season.

GAME FISH PRESENT: Brook trout, mountain whitefish, burbot, arctic grayling.

FISHERY:

A 1,000 ft section of the North Fork Big Hole River was electrofished on July 26 and August 10, 1979. Game fish present in descending order of abundance were brook trout, mountain whitefish, burbot and arctic grayling. Mottled sculpin, longnose dace and longnose sucker was the non-game species captured (Table 2-66).

Table 2-66. Summary of electrofishing survey data collected for a 1,000 ft section of the North Fork Big Hole River (T1S, R15W, Sec. 32 Center) on July 26 and August 10, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	96	1.0 - 15.9
Mountain whitefish	28	3.0 - 16.6
Burbot	10	4.8 - 8.2
Arctic grayling	1	9.6
Mottled sculpin	-	-
Longnose dace	-	-
Longnose sucker	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-67). This 1,000 ft section supported approximately 168 trout 4 inches and longer, weighing 52 pounds. About 24% of the population exceeded 10 inches and trout exceeding one pound comprised 10% of the estimated biomass. The large size of the fish coupled with the fairly substantial numbers make the North Fork one of the more popular brook trout fisheries in the Big Hole drainage.

Table 2-67. Estimated standing crop of brook trout in a 1,000 ft section of the North Fork Big Hole River (T1S, R15W, Sec. 32 Center) on July 26, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	43	
	6.0 - 9.9	84	
	10.0 - 15.9	41	
		168(±65)	52(±21)

In 1978 and 1979, Liknes (1981) captured arctic grayling fry and older individuals in the lower reaches of the North Fork. This indicates reproduction by a resident population or use of the North Fork by the main river population as a reproductive site. The fluvial (stream-dwelling) form of arctic grayling is classified as a species of "special concern" in Montana. Once widely distributed throughout the Missouri River drainage above Great Falls, the fluvial grayling is now found only in remnant populations in the upper Big Hole drainage. Vincent (1962) cites agricultural practices that

decrease fish movement, alter temperature regimes, decrease stream flows and increase sedimentation and turbidity as possible causes for the decline of the fluvial arctic grayling in Montana. It is imperative that instream flow protection is secured for those streams still supporting fluvial arctic grayling.

WILDLIFE:

The North Fork drainage seasonally supports elk, mule deer and black bear from spring through fall and provides exceptional winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 118 ft section of the North Fork Big Hole River in T1S, R15W, Sec. 32 Center. Five cross-sections defining the various habitat types were established. The WETP program was calibrated to field data collected at flows of 26.8 and 183.8 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-65. An upper inflection point occurs at a flow of about 30 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect crucial habitat for the fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 30 cfs (21,719 A.F./yr)

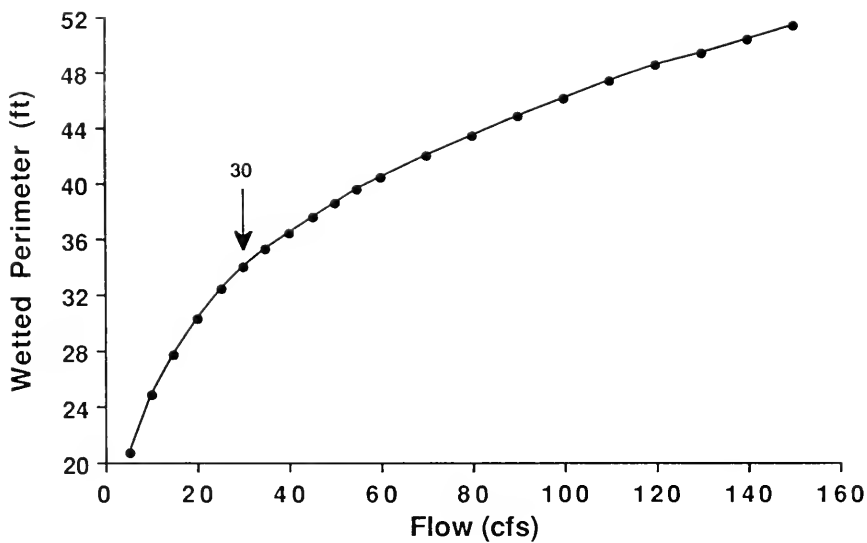


Figure 2-65. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the North Fork Big Hole River.

STREAM NAME: Pintlar Creek

STREAM REACH: From Oreamnos Lake to the mouth - 21.4 miles

LOCATION: Sec. 8, T2N, R15W to Sec. 8, T1S, R14W

DESCRIPTION OF STREAM REACH:

Pintlar Creek originates at Oreamnos Lake in the Anaconda-Pintlar Range of southwest Montana. It flows in a southwesterly direction for about 10.6 miles before entering Pintlar Lake. From the Pintlar Lake outlet the stream flows an additional 10.8 miles before joining the Big Hole River 15 miles east of Wisdom. The majority of the basin is characterized by steep, timbered slopes. The meandering willow-lined channel of the lower valley is surrounded by sagebrush/grassland benches. Ownership of the 31 square mile drainage is shared by the USFS (84%) and private individuals (16%). Seventy-seven percent of the USFS lands lie within the Anaconda-Pintlar Wilderness Area. Bear Lake Creek is the only named tributary within the drainage, although numerous intermittent streams drain the upper reaches. The 25 ft wide channel has an average gradient of 26 ft per 1,000 ft.

Lands within the Pintlar Creek drainage are primarily used for recreation, cattle grazing and, along the lower reaches, hay production. A gravel road parallels the creek along its middle reach, ending at the Wilderness boundary. A USFS campground is located on Pintlar Lake, a natural lake bisecting the drainage.

A dam was built on the outlet of Pintlar Lake to increase its storage capacity for irrigation purposes. The 10.8 mile section of Pintlar Creek below the lake is severely dewatered during the fall and winter when water is stored for the upcoming irrigation season. The lower stream is further dewatered during the summer irrigation season when water is diverted. Consequently, little of its flow enters the Big Hole River during the summer.

GAME FISH PRESENT: Brook trout, burbot, rainbow trout, rainbow x cutthroat hybrid trout, arctic grayling.

FISHERY:

A 1,000 ft section of Pintlar Creek located 0.2 miles below Pintlar Lake was electrofished on July 12 and August 3, 1979. Game fish captured in descending order of abundance were brook trout, burbot and rainbow x cutthroat hybrids. Mottled sculpin and longnose sucker were the only non-game species present (Table 2-68).

Table 2-68. Summary of electrofishing survey data collected for a 1,000 ft section of Pintlar Creek (T1N, R15W, Sec. 14B) on July 12 and August 3, 1979.

Fish Species	Number Captured	Length Range (inches)
Brook trout	74	1.7 - 10.6
Burbot	21	2.2 - 12.5
Rainbow x cutthroat hybrid trout	8	5.7 - 9.5
Longnose sucker	-	-
Mottled sculpin	-	-

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-69). This 1,000 ft section supported a population of about 87 brook trout 4.0 inches and longer, weighing 8 pounds. Of the tributaries to the Big Hole River where population estimates were obtained, Pintlar Creek supported one of the lowest trout standing crops. The condition of the fish, however, was above average for streams in the Beaverhead National Forest. This study section is located immediately below the lake. The severe dewatering that occurs during the fall and winter storage periods may explain the low population of fish in the section.

Table 2-69. Estimated standing crop of brook trout in a 1,000 ft section of Pintlar Creek (T1N, R15W, Sec. 14B) on July 12, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	68	
	6.0 - 9.9	17	
	10.0 - 10.6	2	
		87(±29)	8(±3)

Pintlar Creek above Pintlar Lake, much of which lies within the Pintlar Wilderness Area, supports brook trout (the predominant trout species), rainbow trout, rainbow x cutthroat hybrids, and a few arctic grayling, which likely are migrants from Pintlar Lake. Above the lake, an interconnecting network of beaver ponds - the dominant feature of the stream channel within this section - plays an important role in providing year-round habitat for fish.

WILDLIFE:

The Pintlar Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in an 87 ft section of Pintlar Creek located 0.5 miles below Pintlar Lake (T1N, R15W, Sec. 14B). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 2.0 and 97.1 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle/run cross-sections is shown in Figure 2-66. Lower and upper inflection points occur at about 4 and 10 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing salmonid population, which includes arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

The existing depressed fishery of lower Pintlar Creek does not justify a flow recommendation at the high inflection point. However, a better water management plan for Pintlar Lake would conceivably improve flows in the creek and enhance the stream fishery. For this reason, the high inflection point flow (10 cfs) is recommended. The 10 cfs recommendation provides a goal to strive for should water management practices be modified in the future to benefit the stream fishery.

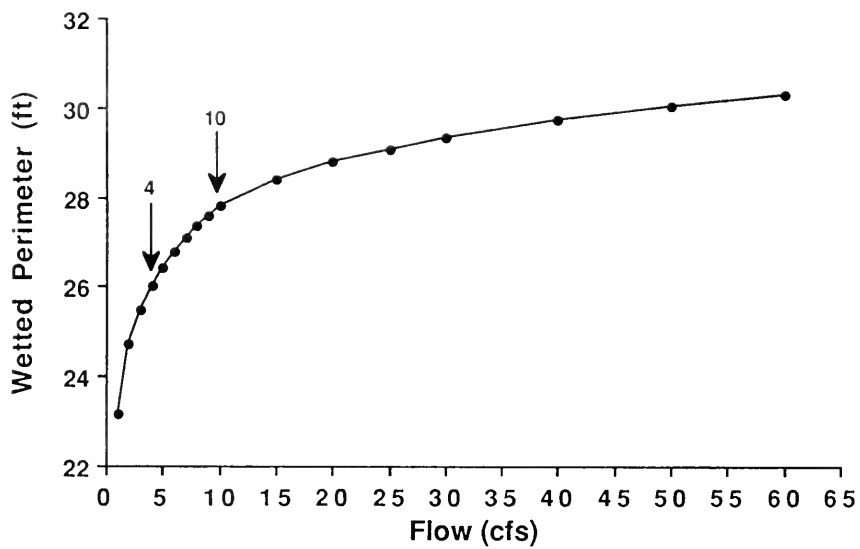


Figure 2-66. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Pintlar Creek.

STREAM NAME: Fishtrap Creek

STREAM REACH: From the convergence of its West and Middle Forks to the mouth
- 6.2 miles

LOCATION: Sec. 26, T2N, R14W to Sec. 4, T1N, R13W

DESCRIPTION OF STREAM REACH:

Fishtrap Creek originates on the southeast slope of the Anaconda-Pintlar Range of southwest Montana at the convergence of its West and Middle Forks and flows 6.2 miles before entering the Big Hole River. Swamp and Palisade Creeks and the East, West and Middle Forks are the major tributaries. The upper drainage consists of steeply timbered, roadless canyons. Along its lower reaches, gently sloping grassland and sagebrush benches surround the narrow floodplain. The 48.5 square mile drainage is controlled by the USFS (78%), private individuals (9%) and the State of Montana (3%). Sixty percent of the USFS land is within the Anaconda-Pintlar Wilderness Area. The gradient of the 31 ft wide channel averages 17 ft per 1,000 ft.

Lands within the Fishtrap drainage are used for recreation, hay production, livestock grazing and, along the upper reaches, timber harvesting. Recreational activities include fishing, hunting and hiking.

Although only 9% of the Fishtrap drainage is owned by private individuals, 80% of the stream channel is on private lands. The stream is extensively used for irrigation and can become severely dewatered during the irrigation season. The over-grazing of the riparian zone along portions of the channel by livestock has produced trampled banks, a reduction of streambank willows and an increase in stream sediment accumulations.

GAME FISH PRESENT: Brook trout, burbot, rainbow trout, arctic grayling.

FISHERY:

A 1,000 ft section of Fishtrap Creek near its mouth was electrofished on July 17 and August 2, 1979. Two hundred twenty-four brook trout, ranging from 1.6-14.0 inches, 29 burbot from 5.2-9.4 inches and 9 rainbow trout from 5.0-7.8 inches were captured. The mottled sculpin was the only non-game species collected.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-70). The 1,000 ft section supported about 310 brook trout 4.0 inches and longer, weighing 27 pounds. Of the 25 Big Hole tributaries electrofished during 1979-80, Fishtrap Creek supported one of the highest standing crops of brook trout.

Table 2-70. Estimated standing crop of trout in a 1,000 ft section of Fishtrap Creek (T1N, R13W, Sec. 4B) on July 17, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	241	
	6.0 - 9.9	65	
	10.0 - 14.0	4	
		310(±76)	27(±5)

Fishtrap Creek also supports low numbers of fluvial (stream-dwelling) arctic grayling - a species of "special concern" in Montana. On August 25, 1986, Brad Shepard, fishery biologist on the Beaverhead National Forest, captured one 11.5 inch grayling while electrofishing a 200 ft section of lower Fishtrap Creek at about stream mile one. The fluvial arctic grayling, once abundant throughout the upper Missouri River drainage above the Great Falls, now only exists in remnant populations in the Big Hole drainage. It is imperative that instream flow protection is secured for those streams still supporting arctic grayling populations.

WILDLIFE:

The Fishtrap Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected for a 68 ft riffle-run sequence located in T1N, R13W, Sec. 4B. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 8.2 and 86.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-67. Lower and upper inflection points occur at about 4.5 and 10.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect crucial habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

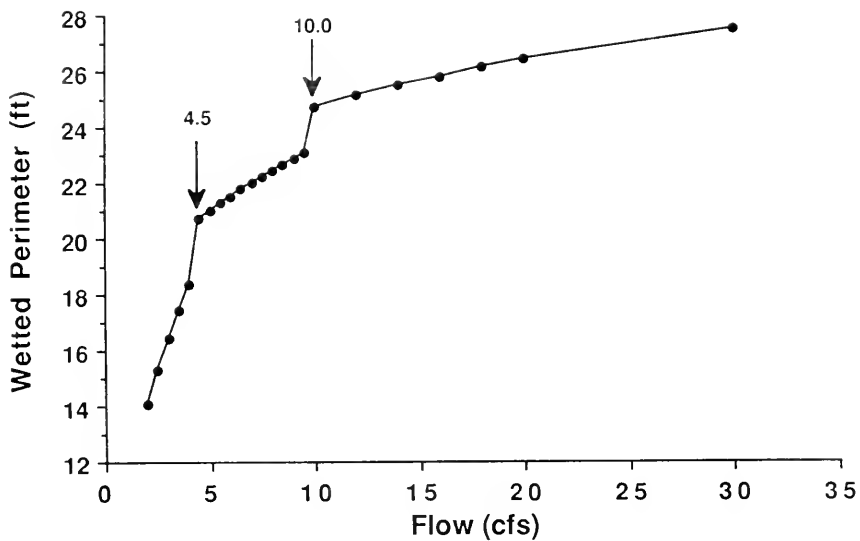


Figure 2-67. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Fishtrap Creek.

STREAM NAME: LaMarche Creek

STREAM REACH: From the confluence of its West and Middle Forks to the mouth
- 8.1 miles

LOCATION: Sec. 6, T2N, R13W to Sec. 34, T2N, R13W

DESCRIPTION OF STREAM REACH:

LaMarche Creek originates in the Anaconda-Pintlar Range of southwest Montana at the confluence of its West and Middle Forks. The stream flows in a narrow floodplain in a southeasterly direction for 8.1 miles before entering the Big Hole River. The LaMarche Creek drainage is characterized by steep, timbered headwater canyons which form a fan shaped basin. Ninety-four percent of the 52 square mile drainage is controlled by the USFS, with 64% of this land in the Anaconda-Pintlar Wilderness Area. The remaining 6% of the drainage is divided equally between private owners and the BLM. The 32 ft wide main channel has an average gradient of 11 ft/1,000 ft.

Land uses in the LaMarche Creek drainage include ranching, timber harvesting and recreation. Fishing, hunting, camping and hiking are popular recreational activities. A gravel road parallels the stream for its lower 4 miles, ending at the LaMarche Creek Guest Ranch.

Hay production and cattle grazing primarily occur along the lower reaches of the stream although grazing allotments also exist on USFS lands. Water from LaMarche Creek is diverted from its lower reaches for irrigation, causing severe dewatering during the summer irrigation season. Bank erosion and loss of streambank vegetative cover and undercut banks have occurred along portions of the lower stream as a result of overgrazing in the riparian zone. These abuses, coupled with the reduction in natural flows, have caused sediments to accumulate in riffle and pool areas of the stream.

GAME FISH PRESENT: Brook trout, rainbow trout, burbot, arctic grayling.

FISHERY:

A 1,000 ft section of LaMarche Creek above the USFS boundary was electrofished on July 12 and August 2 and 9, 1979. Two hundred fifty-three brook trout, ranging from 2.4-12.4 inches, and 5 rainbow trout from 4.0-8.3 inches were captured. Other species present were burbot, longnose sucker and mottled sculpin.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-71). This 1,000 ft section supported about 505 brook trout 4.0 inches and longer, weighing 54 pounds. Of the tributaries to the Big Hole River that were electrofished, LaMarche Creek supported one of the highest standing crops of brook trout. The population of rainbow trout could not be estimated due to the low numbers captured.

Table 2-71. Estimated standing crop of brook trout in a 1,000 ft section of LaMarche Creek (T2N, R13W, Sec. 16C) on July 12, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	289	
	6.0 - 9.9	198	
	10.0 - 12.4	18	
		505(±100)	54(±11)

Although not captured during the 1979 electrofishing survey, Liknes (1981) found age I+ and older arctic grayling in the lower stretches of LaMarche Creek. The fluvial arctic grayling is classified as a species of "special concern" in Montana. Once widely distributed throughout the upper Missouri River drainage, remnant populations of the fluvial form are now found only in the upper Big Hole River and selected tributaries. It is imperative that instream flow protection is secured for those streams still supporting arctic grayling populations.

WILDLIFE:

The LaMarche Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 94 ft riffle-pool sequence located 2.5 miles upstream of the USFS boundary (T2N, R13W, Sec. 21A). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 9.1, 25.0 and 158.2 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-68. Lower and upper inflection points occur at about 5 and 11 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect critical habitat for fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 11 cfs (7,964 A.F./yr)

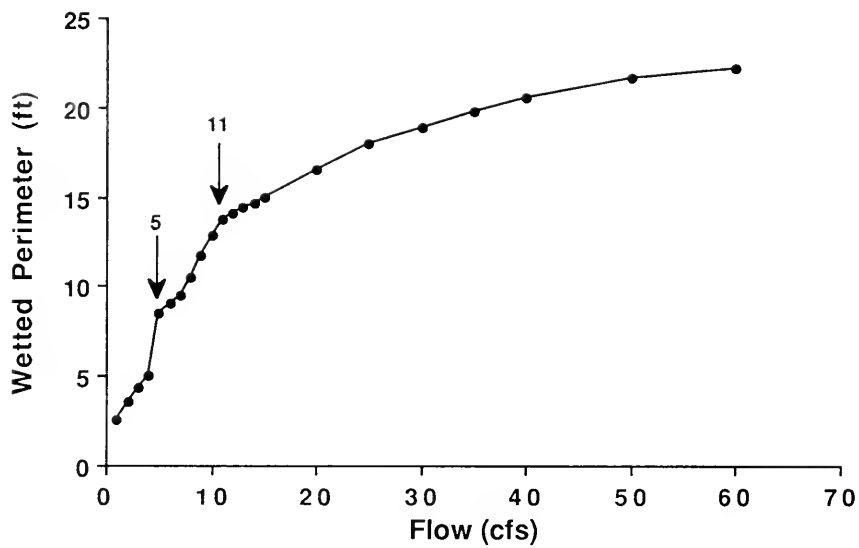


Figure 2-68. The relationship between wetted perimeter and flow for a single riffle cross-section in LaMarche Creek.

STREAM NAME: Seymour Creek

STREAM REACH: From Upper Seymour Lake to the mouth - 15.8 miles

LOCATION: Sec. 6, T3N, R13W to Sec. 31, T2N, R12W

DESCRIPTION OF STREAM REACH:

Seymour Creek originates at Upper Seymour Lake on the east slope of the Anaconda-Pintlar Range at the Continental Divide. The extreme upper reaches of the stream lie within the Anaconda-Pintlar Wilderness Area. The stream flows in a southerly direction for 15.8 miles to its confluence with the Big Hole River. The majority of the 31.7 square mile drainage lies within the Beaverhead and Deerlodge National Forests, while smaller portions of the lower drainage are under the control of the MDFWP (Mt. Haggin Wildlife Mgmt. Area) and private landowners. The upper drainage is characterized by alpine meadows and steep, heavily timbered canyons and ridges. The stream meanders through broad willow bottoms and grass and sedge meadows in the lower drainage. Upper and Lower Seymour Lakes as well as numerous unnamed lakes lie within the drainage. Riparian vegetation is primarily composed of willow, alder, grasses and sedges. Numerous beaver ponds dot the lower drainage. The only major tributary to Seymour Creek is Chub Creek. The average gradient of the 22 ft wide channel is 36.7 feet per 1,000 feet.

Lands within the Seymour Creek drainage are used for recreation in the form of hunting, fishing, trapping, camping, backpacking and winter sports. Past and present commercial uses of the drainage include livestock grazing and timber harvesting. Water is diverted from lower Seymour Creek to irrigate crop lands.

Streambanks and riparian areas along Seymour Creek are in good condition. Potential environmental concerns are sedimentation from existing roads and clear cuts, and damage to riparian areas and banks from cattle.

CAME FISH PRESENT: Brook trout.

FISHERY:

A 1,000 ft section of Seymour Creek was electrofished on August 11 and 25, 1980. Two hundred seventy-three brook trout, ranging from 2.2-10.2 inches, were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-72). This 1,000 ft section supported about 519 brook trout 3.2 inches and longer, weighing 41 pounds. Catchable trout (6 inches and longer) totaled 173, as compared to an average of 88 per 1,000 ft for all Mount Haggin streams. Mean condition (length to weight ratio) of the brook trout was slightly below the average for Mount Haggin streams and other tributaries to the upper Big Hole River. These data indicate that Seymour Creek supports an excellent population of brook trout.

Table 2-72. Estimated standing crop of brook trout in a 1,000 ft section of Seymour Creek (T2N, R13W, Sec. 13D) on August 11, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.2 - 4.9	263	
	5.0 - 6.9	177	
	7.0 - 10.2	<u>79</u>	
		519(±111)	41(±5)

Low numbers of arctic grayling have been collected in Deep and LaMarche Creeks, the two tributaries to the Big Hole River immediately downstream and upstream from Seymour Creek. It is possible that small numbers of arctic grayling currently inhabit portions of Seymour Creek as well, although none were captured in the study section.

WILDLIFE:

The Seymour Creek drainage supports a high density population of elk from spring through fall and provides high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 321 ft riffle-run sequence located approximately at stream mile 3.6 (T2N, R13W, Sec. 13D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 10.1, 55.0 and 87.6 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-69. Lower and upper inflection points occur at about 7 and 13 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect potential habitat of fluvial arctic grayling; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 13 cfs (9,412 A.F./yr)

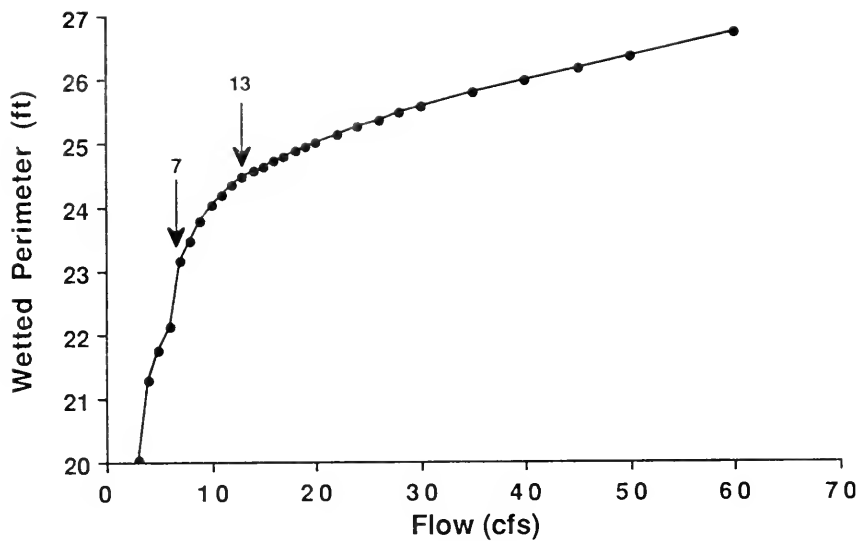


Figure 2-69. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Seymour Creek.

STREAM NAME: Sevenmile Creek

STREAM REACH: From the headwaters to the mouth - 5.1 miles

LOCATION: Sec. 11, T3N, R12W to Sec. 34, T3N, R12W

DESCRIPTION OF STREAM REACH:

Sevenmile Creek originates on the east slope of the Anaconda-Pintlar Range at the Continental Divide and flows in a southerly direction for about 5.1 miles to its juncture with Tenmile Creek to form Deep Creek. The stream drops rapidly through a narrow, steep canyon in the upper reaches and meanders through grasslands and willow bottoms in the lower reaches. The 5 square mile drainage is characterized by open, south facing slopes and timbered, coniferous ridges. Streamside vegetation is comprised primarily of willow, alder, grasses and sedges. Numerous beaver ponds are found in the lower reaches of the stream. Sevenmile Creek has no major tributaries. The average gradient of the 6.1 ft wide channel is 37.2 feet per mile. Much of the Sevenmile Creek drainage is owned by the MDFWP (Mt. Haggin Wildlife Mgmt. Area), while a small portion is under USFS control.

Lands within the Sevenmile Creek drainage are used for recreation, primarily hunting, fishing and snowmobiling. Past uses include livestock grazing, logging, mining, and the diversion of water for agriculture. Present commercial uses include livestock grazing and possibly logging in the future. Streambank instability and soil erosion along the lower reaches of the stream, resulting from vehicular travel and livestock use, are environmental concerns.

GAME FISH PRESENT: Brook trout, rainbow trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Sevenmile Creek was electrofished on August 12 and 21, 1980. One hundred forty-nine brook trout, ranging from 2.1-10.1 inches, and 3 rainbow and rainbow x cutthroat hybrid trout from 4.8-7.7 inches were captured. Non-game species present were mottled sculpin and longnose sucker.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-73). This 1,000 ft section supported approximately 183 brook trout 3.0 inches and longer, weighing 13 pounds. Catchable fish (6 inches and longer) comprised 30 percent of the population. Brook trout condition (length to weight ratio) was slightly below average for Mount Haggin streams and other streams in the upper Big Hole River drainage.

Table 2-73. Estimated standing crop of trout in a 1,000 ft section of Severnile Creek (T3N, R12W, Sec. 34A) on August 12, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.0 - 4.9	83	
	5.0 - 6.4	68	
	6.5 - 10.1	<u>31</u>	
		183(±29)	13(±2)

WILDLIFE:

The Sevenmile Creek drainage supports a high density population of elk from spring through fall and provides high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 190 ft run sequence located at about stream mile 0.1 (T3N, R12W, Sec. 34BC). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 1.8, 5.7 and 12.7 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle/run cross-sections is shown in Figure 2-70. Lower and upper inflection points occur at about 0.8 and 1.8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.8 cfs (1,303 A.F./yr)

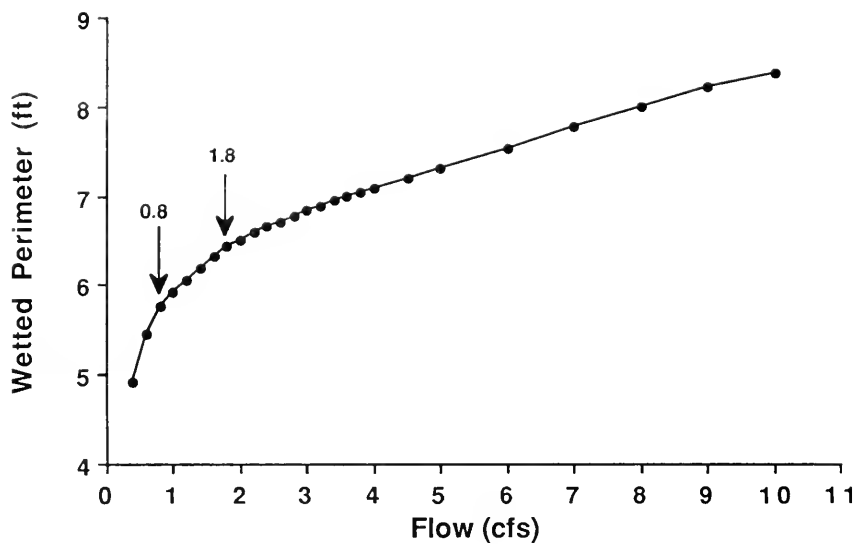


Figure 2-70. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Sevenmile Creek.

STREAM NAME: Tenmile Creek

STREAM REACH: From Tenmile Lakes to the mouth - 8.4 miles

LOCATION: Sec. 6, T3N, R12W to Sec. 34, T3N, R12W

DESCRIPTION OF STREAM REACH:

Tenmile Creek originates at Tenmile Lakes on the east slope of the Anaconda-Pintlar Range at the Continental Divide. The stream flows in a southerly direction for 8.4 miles to its juncture with Sevenmile Creek to form Deep Creek. The 9.6 square mile drainage is characterized by high alpine meadows and numerous mountain lakes, timbered slopes and ridges and, at lower elevations, broad willow bottoms. Conifers surround the upper stream reaches, while a willow-grass-sedge riparian zone borders the lower stream. The lower stream contains numerous beaver ponds. The average gradient of the 12.3 ft wide channel is 57.9 ft per 1,000 ft. The majority of the Tenmile Creek drainage lies within the Deerlodge National Forest, while the lower portion is within the Mt. Haggin Wildlife Mgmt. Area owned by the MDFWP.

Lands within the Tenmile Creek drainage are used for recreation in the form of hunting, fishing, trapping, backpacking, camping and winter sports. Past commercial uses include logging, livestock grazing and diversion of water for irrigation. Present commercial uses include livestock grazing, logging and commercial guiding and outfitting.

GAME FISH PRESENT: Brook trout, rainbow trout, burbot.

FISHERY:

A 1,000 ft section of Tenmile Creek was electrofished on August 12 and 21, 1980. Two hundred twenty-one brook trout, ranging from 2.0-10.9 inches, and 3 rainbow trout from 4.3-7.7 inches were captured. Other species present were burbot (one captured) and mottled sculpin.

The standing crop of brook trout in the study section was estimated using a mark-recapture method (Table 2-74). The section supported about 353 brook trout 3.0 inches and longer, weighing 31 pounds. Catchable fish (6 inches and longer) comprised 32 percent of the population. Tenmile Creek supported a very good brook trout fishery relative to most other Mount Haggin streams. Numbers of catchable fish, brook trout condition, and average weight and biomass were well above average for Mount Haggin streams.

Table 2-74. Estimated standing crop of brook trout in a 1,000 ft section of Tenmile Creek (T3N, R12W, Sec. 34B) on August 12, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.0 - 4.9	179	
	5.0 - 6.9	117	
	7.0 - 10.9	<u>57</u>	
		353(±57)	31(±5)

WILDLIFE:

The Tenmile Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the main upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected from a 266 ft riffle-run sequence located at about stream mile 0.3 (T3N, R12W, Sec. 34B). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 5.9, 18.4 and 44.0 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-71. Lower and upper inflection points occur at about 1.4 and 3.8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.8 cfs (2,751 A.F./yr)

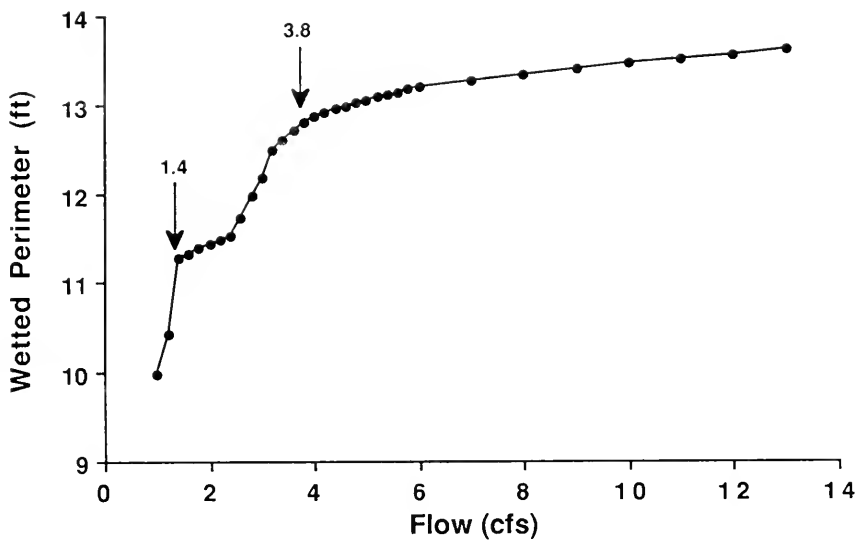


Figure 2-71. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Tenmile Creek.

STREAM NAME: Corral Creek

STREAM REACH: From the headwaters to the mouth - 4.5 miles

LOCATION: Sec. 8, T3N, R12W to Sec. 34, T3N, R12W

DESCRIPTION OF STREAM REACH:

Corral Creek originates in the timbered foothills of the east slope of the Anaconda-Pintlar Range. The stream flows in a southerly direction for 4.5 miles to its confluence with Deep Creek, a tributary to the Big Hole River. The major tributary to Corral Creek is Slaughterhouse Creek. The 5.4 square mile drainage is characterized by steep, heavily timbered slopes in the upper reaches and the broad Deep Creek floodplain at lower elevations. The stream is bordered by coniferous growth, primarily lodgepole pine, in the upper drainage and a broad riparian zone of willow, grasses and sedges in the Deep Creek floodplain. The average gradient of the 5.9 ft wide channel is 46.9 feet per 1,000 feet. The majority of the Corral Creek drainage lies within the boundaries of the Deerlodge National Forest. The lower portion of the drainage is within the Mt. Haggin Wildlife Mgmt. Area owned by the MDFWP.

Lands within the Corral Creek drainage are utilized for recreation in the form of hunting, fishing, trapping and winter sports. Past and present commercial uses of the drainage include livestock grazing and timber harvesting.

Some streambank erosion from cattle grazing occurs along the lower reaches of Corral Creek. Timber harvesting along the upper reaches of Slaughterhouse and Corral Creeks could have an environmental impact through increased sedimentation.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Corral Creek was electrofished on August 13 and 21, 1980. One hundred seventy-three brook trout, ranging from 2.3-10.3 inches, and one 6.8 inch rainbow trout were captured. The mottled sculpin was the only non-game species collected.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-75). The study section supported about 182 brook trout, weighing 19 pounds. Catchable fish (6 inches and longer) accounted for 42% of the population. Brook trout condition (length to weight ratio) was slightly above average for Mount Haggin streams and other upper Big Hole River tributaries. Data from the study section indicate that Corral Creek supports a good fishery for a stream of its size.

Table 2-75. Estimated standing crop of brook trout in a 1,000 ft section of Corral Creek (T3N, R12W, Sec. 34C) on August 13, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 6.9	130	
	7.0 - 10.3	52	
		182(±28)	19(±2)

WILDLIFE:

The Corral Creek drainage supports a high density elk population from spring through fall and provides high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 165 ft riffle-run sequence located at about stream mile 0.2 (T3N, R12W, Sec. 34C). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 1.8, 5.0 and 8.7 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-72. Lower and upper inflection points occur at about 0.6 and 1.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.0 cfs (724 A.F./yr)

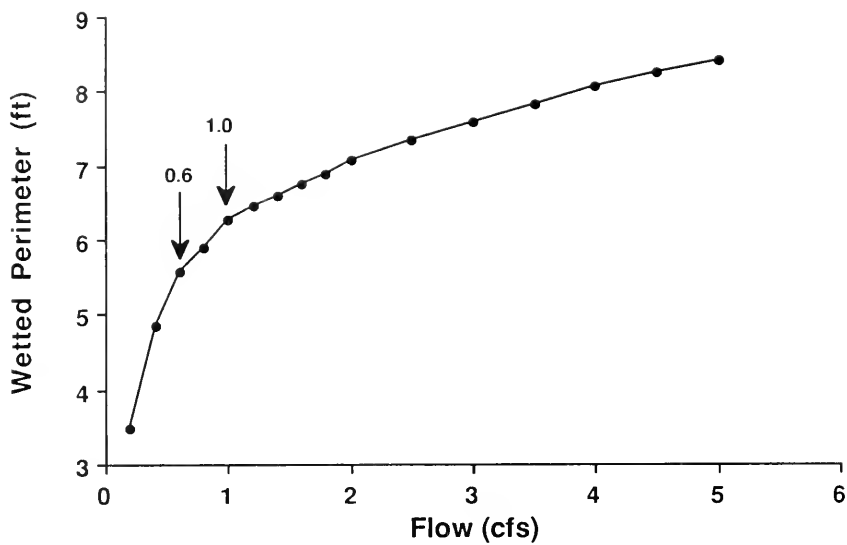


Figure 2-72. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Corral Creek.

STREAM NAME: Twelvemile Creek

STREAM REACH: From the headwaters to the mouth - 9.4 miles

LOCATION: Sec. 2, T3N, R13W to Sec. 4, T2N, R12W

DESCRIPTION OF STREAM REACH:

Twelvemile Creek originates on the east slope of the Anaconda-Pintlar range at the Continental Divide. The stream flows in a southerly direction for approximately 9.4 miles to its confluence with Deep Creek, a tributary to the Big Hole River. The only major tributary to Twelvemile Creek is the West Fork of Twelvemile Creek. The 10 square mile drainage is characterized by high alpine meadows and numerous mountain lakes, timbered ridges and slopes, and, at lower elevations, broad willow bottoms. Along the upper reaches, the stream drops rapidly through dense conifers, while the lower stream meanders through a broad willow-grass-sedge riparian zone within the Deep Creek floodplain. Numerous beaver ponds dot the lower willow bottoms. The average gradient of the 9.5 ft wide channel is 56.4 ft per 1,000 ft. The majority of the Twelvemile Creek drainage is controlled by the USFS, while a smaller portion is owned by the MDFWP (Mt. Haggin Wildlife Mgmt. Area).

Lands within the Twelvemile Creek drainage are used for recreation in the form of hunting, fishing, trapping and winter sports. Past commercial uses include livestock grazing, logging and the diversion of water for irrigation. Present commercial uses include cattle grazing and logging.

The riparian zone and streambanks of Twelvemile Creek are relatively stable and in good condition. Activities that could impair water quality and damage habitat include logging in the upper drainage and cattle grazing along the lower stream reaches.

GAME FISH PRESENT: Brook trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Twelvemile Creek was electrofished on August 6 and 20, 1980. Two hundred seventy-two brook trout, ranging from 2.0-9.6 inches, and one 8.8 inch rainbow x cutthroat hybrid trout were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout in the study section was estimated using a mark-recapture method (Table 2-76). The section supported about 314 brook trout 3.0 inches and longer, weighing 27 pounds. Catchable fish (6 inches and longer) comprised 35% of the population. Twelvemile Creek supports a very good brook trout fishery relative to other streams in the Mount Haggin area. Numbers of catchable fish, average weight and brook trout biomass were above average for Mount Haggin streams.

Table 2-76. Estimated standing crop of trout in a 1,000 ft section of Twelvemile Creek (T2N, R12W, Sec. 4A) on August 6, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.0 - 4.9	143	
	5.0 - 6.9	112	
	7.0 - 9.6	59	
		314(±33)	27(±3)

WILDLIFE:

The Twelvemile Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected from a 232 ft riffle-run sequence located at about stream mile 0.75 (T2N, R12W, Sec. 4A). Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 1.8, 7.7, 16.9 and 24.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-73. Lower and upper inflection points occur at about 0.8 and 1.2 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.2 cfs (869 A.F./yr)

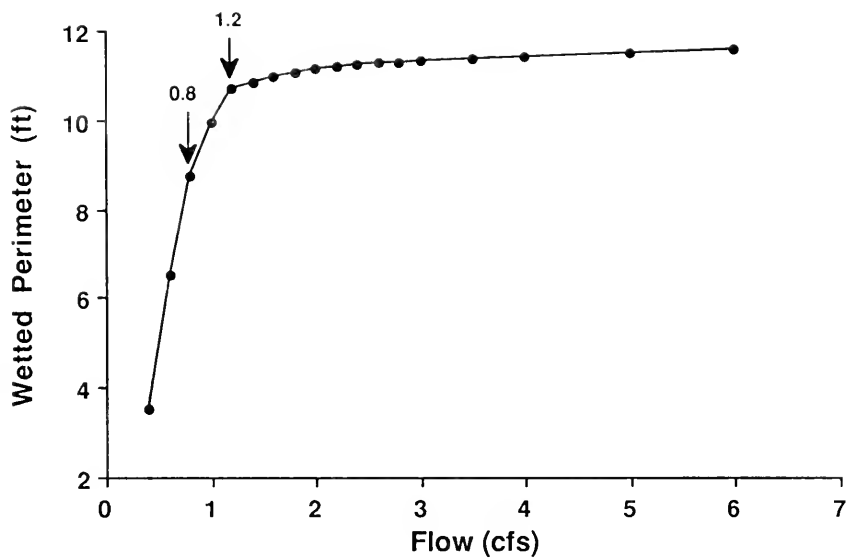


Figure 2-73. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Twelvemile Creek.

STREAM NAME: Sullivan Creek

STREAM REACH: From the headwaters to the mouth - 10.4 miles

LOCATION: Sec. 3, T3N, R13W to Sec. 9, T2N, R12W

DESCRIPTION OF STREAM REACH:

Sullivan Creek originates on the east slope of the Anaconda-Pintlar Range at the Continental Divide. The stream flows in a southerly direction for approximately 10.4 miles to its juncture with Deep Creek, a tributary to the Big Hole River. The major tributary to Sullivan Creek is Bear Trap Gulch Creek. The 9.7 square mile drainage is characterized by high alpine meadows and mountain lakes, steep heavily timbered slopes, and relatively broad willow bottoms as elevation decreases. Conifers surround the upper reaches, while lower elevations are bordered by a willow-grass-sedge riparian zone. The lower stream braids into many channels containing numerous beaver ponds. The average gradient of the 14.3 ft wide channel is 60.8 ft per 1,000 ft. The majority of the Sullivan Creek drainage is owned by the USFS, with smaller portions under MDFWP (Mt. Haggin Wildlife Mgmt. Area) and private control.

Lands within the Sullivan Creek drainage are used for recreation in the form of hunting, fishing, trapping, camping and winter sports. Past commercial uses include logging, livestock grazing and diversion of water for irrigation. Present commercial uses include livestock grazing and, in the upper drainage, logging.

GAME FISH PRESENT: Brook trout.

FISHERY:

A 1,000 ft section of Sullivan Creek was electrofished on August 6 and 20, 1980. Three hundred seventy-five brook trout, ranging from 2.3-9.5 inches, were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout in the study section was estimated using a mark-recapture method (Table 2-77). This 1,000 ft section supported approximately 602 trout 2.5 inches and longer, weighing 29 pounds. Catchable fish (6 inches and longer) accounted for 12% of the population. Brook trout condition (length to weight ratio) was average for Mount Haggin streams and other upper Big Hole River tributaries. Sullivan Creek supported the second highest brook trout population of all Mount Haggin streams surveyed; however, fish numbers were heavily concentrated in the smaller size groups.

Table 2-77. Estimated standing crop of brook trout in a 1,000 ft section of Sullivan Creek (T2N, R12W, Sec. 32A) on August 6, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	2.5 - 3.9	258	
	4.0 - 6.9	324	
	7.0 - 9.5	<u>19</u>	
		602(±63)	29(±3)

WILDLIFE:

The Sullivan Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the main upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 74 ft riffle-run-pool sequence located at about stream mile 2.6 (T2N, R12W, Sec. 29CD). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 5.1, 19.4 and 50.1 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-74. A prominent upper inflection point occurs at about 4.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 4 cfs (2,896 A.F./yr)

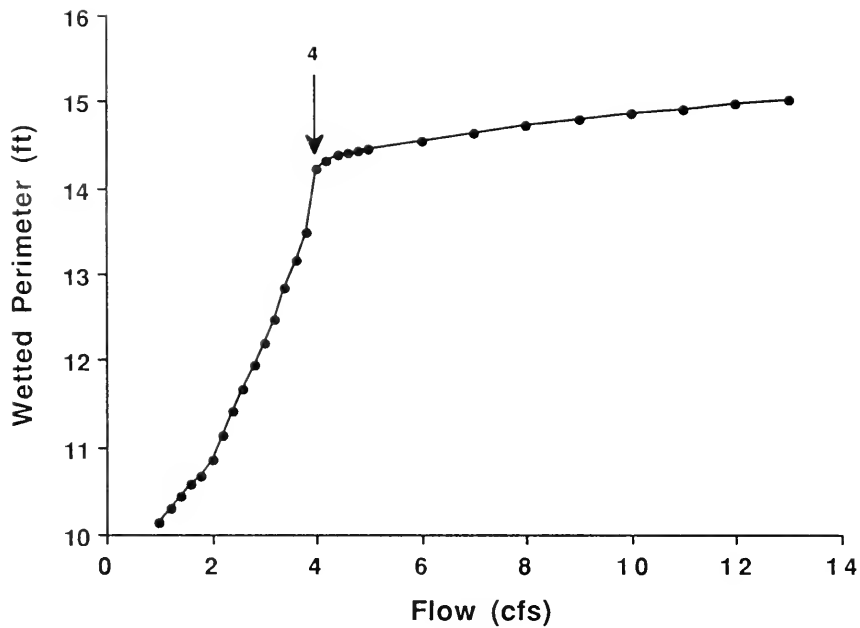


Figure 2-74. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Sullivan Creek.

STREAM NAME: Oregon Creek

STREAM REACH: From the headwaters to the mouth - 2.0 miles

LOCATION: Sec. 20, T3N, R11W to Sec. 30, T3N, R11W

DESCRIPTION OF STREAM REACH:

Oregon Creek originates on the east slope of the Anaconda-Pintlar Range at the Continental Divide and flows in a southerly direction for about 2 miles before entering California Creek. It meanders through a narrow riparian zone vegetated primarily with grasses, sedges and small clumps of willow and alder. Coniferous growth is extremely sparse throughout the 1.8 square mile drainage and streamside canopy is restricted to willow clumps or is lacking. The lower reaches of the stream are bordered by till from a placer mining operation. The drainage is characterized by high, open, south-facing slopes. Oregon Creek has no major tributaries. The average gradient of the 7.5 ft wide channel is 31.6 ft per 1,000 ft. The Oregon Creek drainage is entirely within the Mt. Haggin Wildlife Mgmt. Area, owned by the MDFWP.

Recreational uses in the Oregon Creek drainage include hunting, fishing and snowmobiling. The drainage has been used in the past for livestock grazing, timber harvesting and placer gold mining. Present commercial use of the drainage is confined to cattle grazing.

Water chemistry samples were collected from Oregon Creek during the summer of 1980. Water quality was generally good except for the presence of elevated levels of arsenic and lead. The probable source of the metals is the Anaconda Smelter. Other existing environmental problems include sedimentation from the slumping roadbed of Highway 274, and channel and streambank alterations from past placer mining.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Oregon Creek was electrofished on August 5 and August 14, 1980. Two hundred seventy-five brook trout, ranging from 2.5-11.1 inches, and 4 rainbow trout from 4.6-8.3 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-78). The section supported approximately 265 brook trout 3.5 inches and longer, weighing 24 pounds. Catchable fish (6 inches and longer) comprised 38% of the population. Brook trout condition (length to weight ratio) was excellent and above average for Mount Haggin streams and upper Big Hole River tributaries.

Table 2-78. Estimated standing crop of brook trout in a 1,000 ft section of Oregon Creek (T3N, R11W, Sec. 20C) on August 5, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 6.9	221	
	7.0 - 11.1	<u>44</u>	
		265(±28)	24(±3)

The trout population data for Oregon Creek revealed a good fishery for a stream of its size. Fish in the lower reaches of the stream may be affected by habitat destruction from past placer mining operations and sediment loading from a slumping hillside and subsequent slumping of the roadbed of Highway 274 at the Oregon Creek road crossing.

WILDLIFE:

The Oregon Creek drainage supports elk from spring through fall and provides high quality winter range for moose. Good numbers of black bear also inhabit the drainage. Other wildlife present include beaver, mink, lynx, marten and coyote. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 178 ft riffle-pool-run sequence located at about stream mile 0.2 (T3N, R11W, Sec. 30B). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 0.5, 4.7 and 8.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-75. A prominent upper inflection point occurs at about 0.3 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.3 cfs (217 A.F./yr)

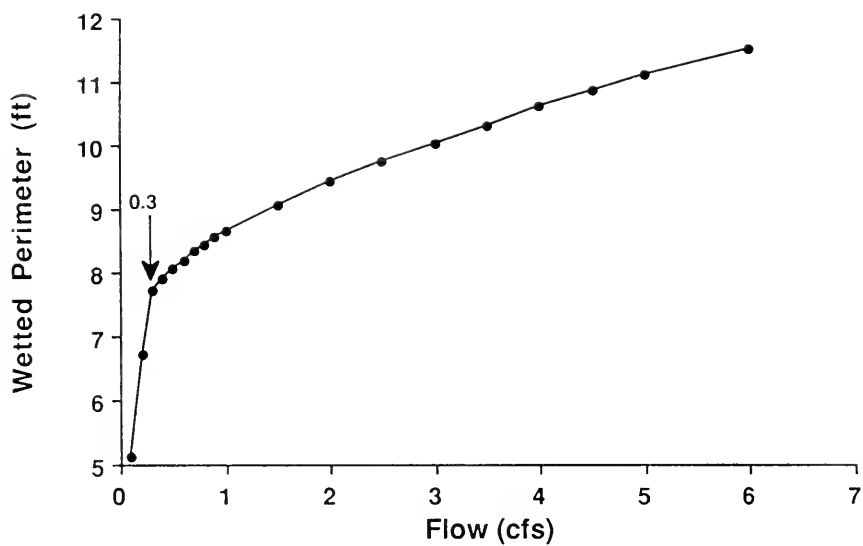


Figure 2-75. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Oregon Creek.

STREAM NAME: Sixmile Creek

STREAM REACH: From the headwaters to the mouth - 3.1 miles

LOCATION: Sec. 12, T3N, R12W to Sec. 25, T3N, R12W

DESCRIPTION OF STREAM REACH:

Sixmile Creek originates on the east slope of the Anaconda-Pintlar Range at the Continental Divide. The stream flows in a southerly direction for approximately 3.1 miles to its confluence with California Creek. The 4.2 square mile drainage is characterized by high, open, south facing slopes having little coniferous growth. The stream drops rapidly through a narrow floodplain vegetated with willow, alder, aspen, grasses and sedges. The average gradient of the 6.3 ft wide channel is 44.1 ft per 1,000 ft. The entire drainage is within the Mt. Haggin Wildlife Mgmt. Area, owned by the MDFWP.

Lands within the drainage are used for recreation in the form of hunting, fishing, and snowmobiling. Past commercial uses include timber harvesting, livestock grazing and the diversion of water to the McCune flume for timber transport and to the Home Ranch for irrigation. Present commercial uses are confined to livestock grazing.

Water chemistry samples were collected from Sixmile Creek during the summer of 1980. Water quality was generally good, although a slight elevation in arsenic was noted. The source of the arsenic is believed to be precipitates from the Anaconda Smelter. The lower reaches of Sixmile Creek exhibit eroded streambanks from past livestock grazing. Areas of channel instability exist in the vicinity of the Mule Ranch.

GAME FISH PRESENT: Brook trout, rainbow trout, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Sixmile Creek was electrofished on August 7 and 26, 1980. Game fish captured in descending order of abundance were brook trout, rainbow trout, cutthroat trout and rainbow x cutthroat hybrid trout. The mottled sculpin was the only non-game species collected. Electrofishing survey data are summarized in Table 2-79.

Table 2-79. Summary of electrofishing survey data collected for a 1,000 ft section of Sixmile Creek (T3N, R12W, Sec. 25A) on August 7 and 26, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	189	1.0 - 9.7
Rainbow trout	19	3.7 - 7.0
Cutthroat trout	3	4.8 - 8.2
Rainbow x cutthroat hybrid trout	2	5.4 - 9.5

Standing crops of brook and rainbow trout were estimated using a mark-recapture method (Table 2-80). The section supported about 392 brook trout and 20 rainbow trout, having a combined weight of 14 pounds. Eighty-five percent of the brook trout population was less than 5 inches and 66 percent was less than 3 inches. Brook trout condition (length to weight ratio) was above average for Mount Haggin streams and other upper Big Hole River tributaries.

Table 2-80. Estimated standing crops of brook and rainbow trout in a 1,000 ft section of Sixmile Creek (T3N, R12W, Sec. 25A) on August 7, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	1.0 - 2.9	259	
	3.0 - 4.9	76	
	5.0 - 6.9	34	
	7.0 - 9.7	23	
		392(±119)	13(±2)
Rainbow trout	3.5 - 7.0	20(±3)	1(±0)

Fishery data for the Sixmile Creek study section suggest that the stream may be an important rearing area for the California-French Creek drainage. The presence of small numbers of cutthroat leads to the possibility that larger populations may exist in the upper drainage. Such populations would enhance the fishery values of Sixmile Creek.

WILDLIFE:

The Sixmile Creek drainage supports a high density population of elk from spring through fall and provides high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 165 ft riffle-run sequence located at about stream mile 0.5 (T3N, R12W, Sec. 25A). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 1.8, 3.2, 6.6 and 21.5 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-76. Lower and upper inflection points occur at about 0.6 and 1.6 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations, which may include westslope cutthroat trout - a species of "special concern" in Montana; to maintain possible spawning and rearing habitats for migrant trout from the California-French Creek drainages; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.6 cfs (1,158 A.F./yr)

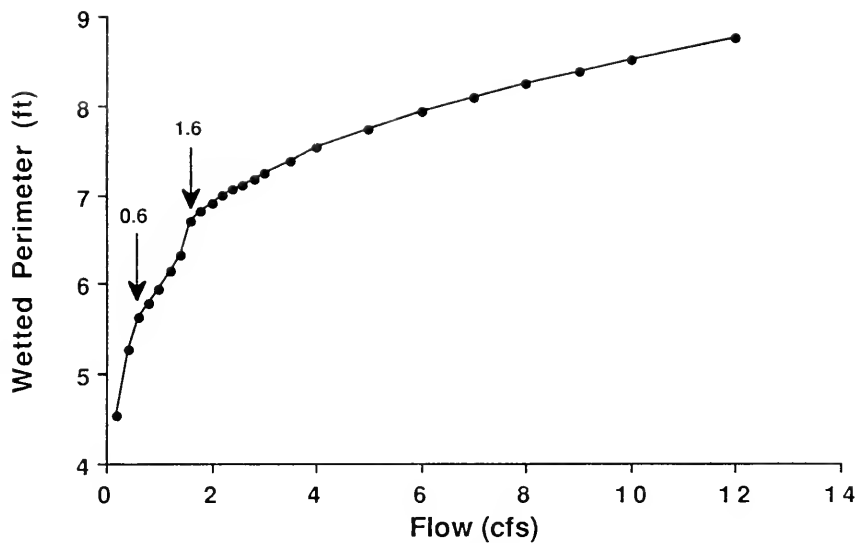


Figure 2-76. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Sixmile Creek.

STREAM NAME: American Creek

STREAM REACH: From the headwaters to the mouth - 5.7 miles

LOCATION: Sec. 11, T2N, R11W to Sec. 25, T3N, R12W

DESCRIPTION OF STREAM REACH:

American Creek originates on the eastern slope of the Anaconda-Pintlar Range at the Continental Divide. It flows in a westerly direction for 5.7 miles to its confluence with California Creek, a tributary to French Creek. American Creek meanders through a relatively narrow floodplain vegetated with willow, alder, grasses and sedges and containing numerous beaver ponds. The 7.1 square mile drainage area is characterized by high south facing meadows and heavily timbered slopes. The only major tributary to American Creek is Little American Creek. Average gradient of the 11 ft wide channel is 46.6 ft per 1,000 ft. The American Creek drainage is within the Mt. Haggin Wildlife Mgmt. Area, owned by the Montana Department of Fish, Wildlife and Parks.

Lands within the American Creek drainage are used for recreation in the form of hunting, fishing, trapping, and snowmobiling. Past commercial uses include livestock grazing, logging and diversion of water to Moose Creek for the Anaconda timber flume. Grazing of cattle and logging continue in the drainage today.

American Creek is bordered by a relatively broad riparian zone and stable banks. Potential environmental problems include sedimentation from existing and proposed areas of timber harvest and damage to the stream banks and riparian zone from cattle.

GAME FISH PRESENT: Brook trout, rainbow trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of American Creek was electrofished on August 7 and 19, 1980. Game fish captured in descending order of abundance were brook trout, rainbow trout and rainbow x cutthroat hybrids. The mottled sculpin was the only non-game species captured (Table 2-81).

Table 2-81. Summary of electrofishing survey data collected for a 1,000 ft section of American Creek (T3N, R11W, Sec. 30C) on August 7 and 19, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	147	2.0 - 10.2
Rainbow trout	8	6.4 - 9.2
Rainbow x cutthroat hybrid trout	1	9.5
Mottled sculpin	-	-

Standing crops of brook trout and rainbow trout were estimated using a mark-recapture method (Table 2-82). The section supported approximately 160 brook trout and 8 rainbow trout, having a combined biomass of 13 lbs. Catchable fish (6 inches and longer) comprised 24% of the brook trout population. Brook trout condition (length to weight ratio) was good although slightly below average when compared with other streams in the upper Big Hole River drainage.

Table 2-82. Estimated standing crops of brook and rainbow trout in a 1,000 ft section of American Creek (T3N, R11W, Sec. 30C) on August 7, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.2 - 5.9	122	
	6.0 - 10.2	<u>38</u>	
		160(±24)	12(±1)
Rainbow trout	6.4 - 9.2	8(±3)	1(±0)
Total trout		168(±24)	13(±1)

WILDLIFE:

The American Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the main upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected for a 169 ft riffle-run sequence located approximately at stream mile 0.2 (T3N, R12W, Sec. 25D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 6.7, 11.2, 16.6 and 31.8 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-77. Lower and upper inflection points occur at about 1.8 and 2.8 cfs, respectively.

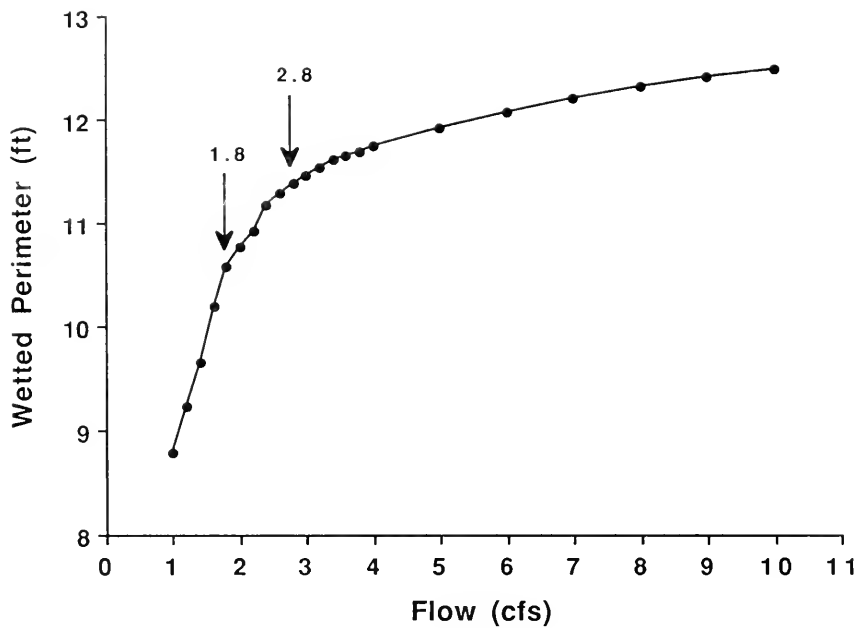


Figure 2-77. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in American Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.8 cfs (2,027 A.F./yr)

STREAM NAME: California Creek

STREAM REACH: From the headwaters to the mouth - 8.1 miles

LOCATION: Sec. 14, T3N, R11W to Sec. 1, T2N, R12W

DESCRIPTION OF STREAM REACH:

California Creek originates on the eastern slope of the Anaconda-Pintlar Range at the Continental Divide. It flows in a southerly direction for approximately 8.1 miles to its junction with French Creek. California Creek meanders through a narrow floodplain characterized by a relatively narrow riparian zone. For most of its length, the stream is bordered by grass and sedge meadows containing scattered clumps of willow and alder. The 28.4 square mile drainage is characterized by high south-facing slopes having little coniferous growth in the headwater region, and timbered foothills and grass-sedge meadows downstream. Major tributaries to California Creek include Crooked John, Little California, Oregon, Sixmile and American Creeks. The average gradient of the 22 ft wide channel is 29.5 ft per 1,000 ft. The majority of the California Creek drainage is within the Mt. Haggin Wildlife Mgmt. Area owned by the MDFWP. A small portion lies on USFS lands.

Lands within the California Creek drainage are used for recreation in the form of hunting, fishing and trapping. Past commercial uses of the drainage include placer mining, logging, livestock grazing and diversion of water for irrigation and timber transport. Grazing and logging continue in the drainage today.

Relatively high arsenic, iron and suspended sediment levels occur in California Creek. The source of the arsenic is probably precipitates from the Anaconda Smelter. The source of the sediment and iron is believed to be erodible soils in the vicinity of Sugarloaf Mountain. This area was clear-cut in the late 1800's and has revegetated very slowly due to toxic precipitates from the Anaconda Smelter, sheep grazing and fires. The California Creek stream banks and riparian areas exhibit evidence of erosion and trampling from concentrations of cattle.

GAME FISH PRESENT: Brook trout, rainbow trout, mountain whitefish, burbot.

FISHERY:

A 1,000 ft section of California Creek was electrofished on August 4 and 18, 1980. Game fish captured in descending order of abundance were brook trout, rainbow trout, mountain whitefish and burbot. Non-game species captured were mottled sculpin, longnose sucker and longnose dace. The electrofishing survey data are summarized in Table 2-83.

Table 2-83. Summary of electrofishing survey data collected for a 1,000 ft section of California Creek (T2N, R12W, Sec. 1B) on August 4 and 18, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	97	3.6 - 10.2
Rainbow trout	23	2.4 - 8.9
Mountain whitefish	9	6.8 - 12.6
Burbot	1	11.0
Mottled sculpin	-	-
Longnose sucker	-	-
Longnose dace	-	-

Standing crops of brook trout and rainbow trout were estimated using a mark-recapture method (Table 2-84). The section supported approximately 130 brook trout and 30 rainbow trout, having a combined biomass of 19 pounds. Catchable fish (6 inches and longer) comprised 55% of the brook trout and 47% of the rainbow trout populations. Brook trout condition (length to weight ratio) was above average for streams in the Big Hole River drainage

Table 2-84. Estimated standing crops of brook and rainbow trout in a 1,000 ft section of California Creek (T2N, R12W, Sec. 1B) on August 4, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.6 - 6.9	86	
	7.0 - 10.2	<u>44</u>	
		130(±20)	16(±2)
Rainbow trout	4.0 - 8.9	30(±10)	3(±1)
Total trout		160(±22)	19(±2)

WILDLIFE:

The California Creek drainage supports elk from spring through fall and provides high quality winter range for moose. Good numbers of black bear inhabit the drainage. Other wildlife present include beaver, mink, lynx, marten and coyote. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 252 ft riffle-run sequence located at about stream mile 0.15 (T2N, R12W, Sec. 1B). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 14.0, 43.1 and 94.6 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-78. Lower and upper inflection points occur at about 10 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident game fish populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

The brook trout population of California Creek was low (40% of average) when compared with other streams on the Mt. Haggin Wildlife Mgmt. Area. The relatively large size of California Creek and the frequency of relatively deep pool habitat gave the appearance of a stream capable of supporting a larger population of game fish. The relatively low numbers of trout may be related to sediment loading, high arsenic and iron levels or bank instability due to intense livestock use. While present game fish populations in the section are below average, it is probable that California Creek has the potential to support greater numbers of fish if present environmental problems, particularly toxic metals pollution, are corrected in the future. For this reason, the high inflection point flow (14 cfs) is requested.

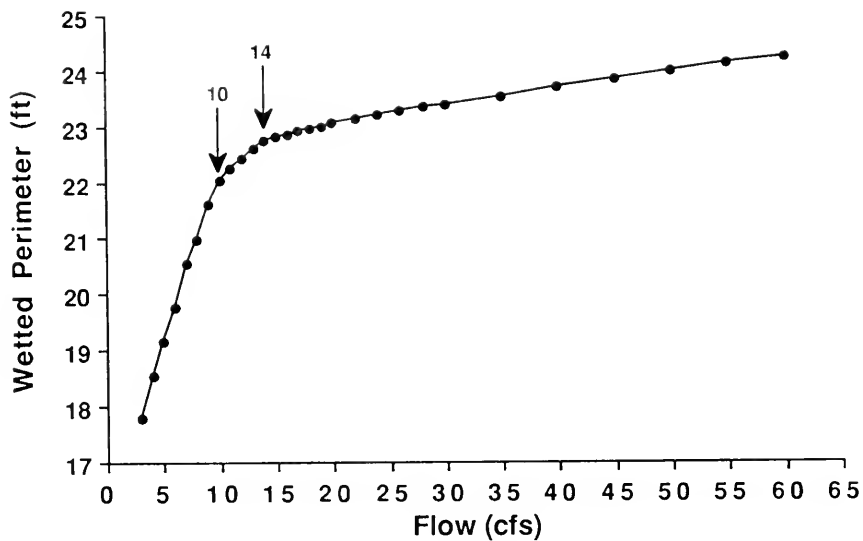


Figure 2-78. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in California Creek.

STREAM NAME: French Creek

STREAM REACH: From the headwaters to the mouth - 9.6 miles

LOCATION: Sec. 8, T2N, R11W to Sec. 21, T2N, R12W

DESCRIPTION OF STREAM REACH:

French Creek originates on the eastern slope of the Anaconda-Pintlar Range and flows in a southerly direction for 9.6 miles before entering Deep Creek, a tributary to the Big Hole River. French Creek meanders through a narrow floodplain vegetated with willows, grasses and sedges. The stream drains high south facing meadows and timbered hillsides. Ownership of the 46 square mile drainage is shared by the Montana Department of Fish, Wildlife and Parks (78%), the USFS (17%) and private individuals (1%). Much of the flow of French Creek originates in the California Creek drainage. Other smaller tributaries include Moose Creek and Julius and First Chance Gulches. Average gradient of the 20 ft wide channel is 33 ft per 1,000 ft. Access to the stream is provided by Highway 274 and undeveloped roads throughout the Mt. Haggin Wildlife Mgmt. Area.

Lands within the French Creek drainage are used for recreation in the form of hunting and fishing, grazing of livestock, timber harvesting, wildlife propagation and, historically, mining. The Mt. Haggin Livestock Company continues to hold a cattle grazing lease on the game management area and a logging contract is held by Louisiana Pacific for the harvesting of timber.

Water chemistry samples were collected by the Department of Fish, Wildlife and Parks during the summer of 1980 on French Creek and its tributaries (Oswald, 1981). The elevated levels of suspended sediment, arsenic and total iron found in French Creek during certain flow periods may be affecting the aquatic resource. The arsenic is believed to originate from past placer mining in the drainage and from a precipitate emitted by the Anaconda Smelter (Oswald, 1981).

GAME FISH PRESENT: Rainbow trout, brook trout, mountain whitefish, burbot.

FISHERY:

A 1,000 ft section of French Creek was electrofished on July 11 and August 1, 1979. Game fish present in descending order of abundance were rainbow trout, brook trout, mountain whitefish and burbot. Longnose sucker, longnose dace and mottled sculpin were the nongame species captured (Table 2-85).

Table 2-85. Summary of electrofishing survey data collected for a 1,000 ft section of French Creek (T2N, R12W, Sec. 10C) on July 11 and August 1, 1979.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	17	4.1 - 10.2
Brook trout	13	5.5 - 10.4
Mountain whitefish	9	8.3 - 11.5
Burbot	4	7.8 - 9.3
Longnose sucker	48	4.1 - 11.0
Longnose dace	-	-
Mottled sculpin	-	-

The standing crop of game fish in the section could not be estimated due to the low numbers of fish captured. Trout condition (length to weight ratio) was below average for streams surveyed in the Big Hole drainage.

Wipperman (1967) postulated that the low productivity of French Creek may be related to the destruction of riparian vegetation by air pollutants from the Anaconda Smelter, the chemical removal of riparian willows along much of the creek in 1965, and the effects of past mining within the drainage.

Trout populations in California and Oregon Creeks, streams within the French Creek drainage, were estimated by the MDFWP at 130 and 265 brook trout per 1,000 ft, respectively. These stream populations greatly exceed those of French Creek. Like French Creek, both these streams were subject to air pollution from the Anaconda Smelter, were placer mined in the past and have elevated arsenic levels. It appears that the environmental problems affecting French Creek are more severe than those of other streams within the drainage.

WILDLIFE:

The French Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 174 ft section of French Creek located at stream mile 2.0 (R12W, T2N, Sec. 10C). Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 10.6 and 56.3 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-79. Lower and upper inflection points occur at 3 and 6 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 6 cfs (4,344 A.F./yr)

The depressed fishery of French Creek does not warrant a flow recommendation at the high inflection point. However, now that virtually all of the drainage is in public ownership and the Anaconda Smelter has closed, eliminating a major pollution source, the aquatic environment of French Creek could gradually improve, causing the trout population to increase beyond its present low level. To help insure that future flows are sufficient to accommodate a potentially expanding fish population, the flow at the upper inflection point (6 cfs) is requested.

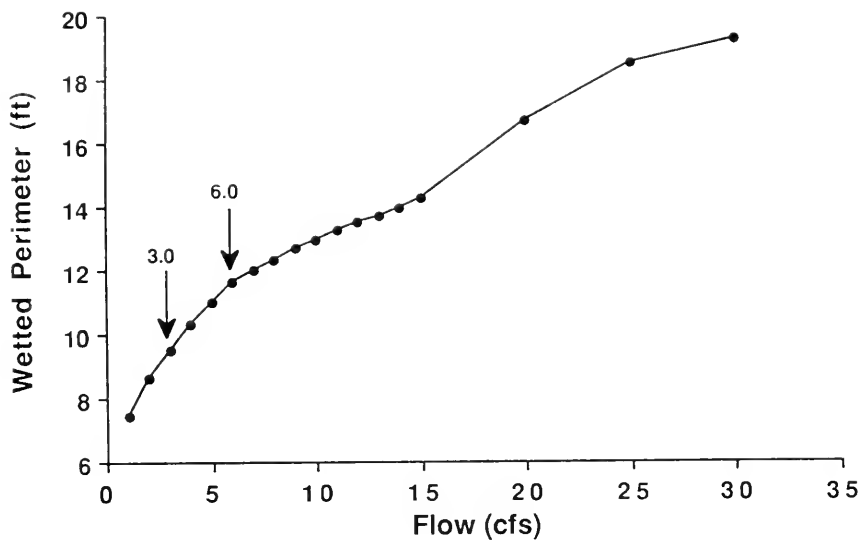


Figure 2-79. The relationship between wetted perimeter and flow for a single riffle cross-section in French Creek.

STREAM NAME: Deep Creek

STREAM REACH: From the confluence of Sevenmile and Tenmile Creeks to the mouth - 9.3 miles

LOCATION: Sec. 34, T3N, R12W to Sec. 32, T2N, R12W

DESCRIPTION OF STREAM REACH:

Deep Creek arises on the southern slope of the Anaconda-Pintlar Range of southwest Montana at the confluence of Tenmile and Sevenmile Creeks. It then meanders through dense willow and alder bottoms in a southerly direction for 9.3 miles before entering the Big Hole River. Other tributaries to Deep Creek include French, Sullivan, Corral and Twelvemile Creeks. Vegetative cover in the 100 square mile drainage consists of coniferous forests in the upper portion, changing to sagebrush/grasslands at lower elevations. The majority of the drainage (63%) was acquired by the Montana Department of Fish, Wildlife and Parks in 1976 to protect an important deer and elk migration route and winter habitat for moose. Ownership of the remainder of the drainage is shared by the USFS (30%), private landowners (5%) and the BLM (2%). Average gradient of the 30 ft wide channel is 8.4 ft/1,000 ft.

Lands within the Deep Creek drainage are used for recreation in the form of hunting, fishing and skiing, timber harvesting, cattle grazing, hay production along the lower stream reaches, and wildlife propagation. The Mt. Haggin Wildlife Mgmt. Area, owned by the MDFWP, is presently one of the more popular elk and mule deer hunting areas in the state.

During the irrigation season, the lower reaches of Deep Creek are diverted, causing severe dewatering. Damage to the stream caused by the trampling of the banks by livestock and grazing in the riparian zone is evident on the lower reaches. A subdivision presently being developed along Deep Creek could contaminate groundwater through improper use or placement of septic tanks, affect the stream recharge rate through well production and alter the floodplain through the drainage of marshy areas.

GAME FISH PRESENT: Brook trout, burbot, rainbow trout, mountain whitefish, arctic grayling.

FISHERY:

A 1,000 ft section of Deep Creek above the mouth of French Creek was electrofished on August 26 and September 9, 1980. A 1,000 ft section below the mouth was electrofished on July 11 and August 2, 1979. Game fish present in both sections were brook trout, rainbow trout, mountain whitefish and burbot. Longnose sucker, longnose dace and mottled sculpin were the non-game species captured. Table 2-86 summarizes the electrofishing survey data for the two sections. In comparing the two sections, approximately eight times more brook trout were captured above the mouth of French Creek than below.

Table 2-86. Summary of electrofishing survey data collected for two 1,000 ft sections of Deep Creek above (T2N, R12W, Sec. 9A) and below (T2N, R12W, Sec. 20D) the mouth of French Creek on August 26 and September 9, 1980 and July 11 and August 2, 1979, respectively.

Species	Number Captured		Length Range (inches)	
	Above French	Below French	Above French	Below French
Brook trout	131	16	2.2 - 9.9	1.6 - 9.9
Rainbow trout	12	18	2.5 - 11.0	5.2 - 10.2
Mountain whitefish	6	19	8.4 - 13.1	10.2 - 12.5
Burbot	13	10	7.2 - 13.0	7.6 - 10.7
Longnose sucker	25	66	4.5 - 12.4	4.6 - 10.1
Longnose dace	-	-	-	-
Mottled sculpin	-	-	-	-

Due to the low numbers of fish captured in the lower section, the standing crop of brook trout could only be estimated in the section above French Creek (Table 2-87). This section supported about 167 brook trout 4.0 inches and longer, weighing 18 pounds. The condition factors for brook trout (length to weight ratio) were below average for streams sampled in the Big Hole drainage.

Table 2-87. Estimated standing crop of brook trout in a 1,000 ft section of Deep Creek located above the mouth of French Creek (T2N, R12W, Sec. 9A) on August 26, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	63	
	6.0 - 9.9	104	
		167(±35)	18(±3)

Electrofishing surveys conducted in 1964 (Wipperman and Needham, 1965) and 1966 (Wipperman, 1967) showed similar results. In both years, numbers of brook trout captured above the French Creek confluence were considerably greater than those below. Within the 2.5 miles between the upper and lower sections, some factor or combination of factors is depressing the trout population. French Creek, whose fishery is also depressed, is the only major tributary entering Deep Creek between these sections.

In addition to supporting a resident trout population, Deep Creek also provides spawning habitat for rainbow trout residing in the Big Hole River. On April 27, 1987, Brad Shepard, fishery biologist on the Beaverhead National Forest, counted five redds and observed five adult rainbow trout actively spawning in the lower two miles of the creek. This spawning survey was conducted very early in the spawning season and does not reflect peak use.

Deep Creek also provides crucial winter habitat for arctic grayling. On October 29, 1987, 23 grayling (mostly yearlings) were captured while electrofishing an approximate $\frac{1}{2}$ mile section of lower Deep Creek. The fluvial (stream-dwelling) arctic grayling is classified as a species of "special concern" in Montana. Once widely distributed throughout the upper Missouri River drainage, remnant populations of fluvial grayling are now only found in the upper Big Hole drainage. It is imperative that instream flow protection is secured for those streams still supporting arctic grayling populations.

WILDLIFE:

The Deep Creek drainage provides excellent winter range for moose and seasonally supports elk in spring and summer. Mink and an excellent population of beaver are associated with the stream and its riparian zone. Blue and spruce grouse are the primary upland game birds within the drainage.

WETTED PERIMETER:

Cross-sectional measurements were collected in a 158 ft section of Deep Creek located near stream mile 2.0 (T2N, R12W, Sec. 20D). Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 33.8 and 187.5 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section is shown in Figure 2-80. Lower and upper inflection points occur at flows of about 10 and 18 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning habitat for rainbow trout from the Big Hole River; to protect crucial habitat for fluvial arctic grayling, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 18 cfs (13,031 A.F./yr)

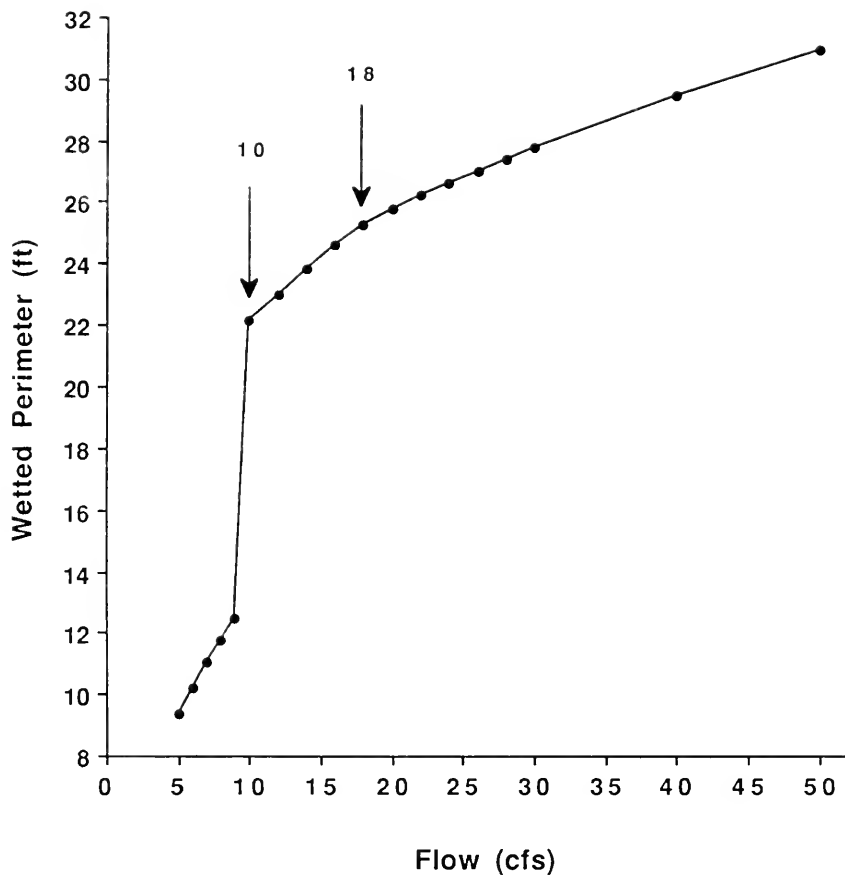


Figure 2-80. The relationship between wetted perimeter and flow for a single riffle cross-section in Deep Creek.

STREAM NAME: Bear Creek

STREAM REACH: From the headwaters to the mouth - 6.3 miles

LOCATION: Sec. 20, T2N, R11W to Sec. 3, T1N, R12W

DESCRIPTION OF STREAM REACH:

Bear Creek originates on the north slope of Dickie Peak at an elevation of approximately 8,200 ft. The stream flows in a southwesterly direction for 6.3 miles to its confluence with the Big Hole River. The only named tributary to Bear Creek is Johnson Gulch Creek. The 8.6 square mile drainage is characterized by steep, heavily timbered slopes with numerous south-facing clearings. The stream is bordered by a relatively broad riparian zone of willow, alder, birch, aspen, grasses and sedges and is characterized by braided channels and numerous beaver ponds in the lower reaches. The average gradient of the 9.6 ft wide channel is 65.8 ft per 1,000 ft. Ownership of the Bear Creek drainage is controlled by the USFS (68%), private individuals (18%) and the BLM (14%).

Lands within the Bear Creek drainage are used for cattle grazing, logging and recreation in the form of hunting, fishing and winter sports. Access is provided by a gravel road which parallels the stream.

GAME FISH PRESENT: Brook trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Bear Creek was electrofished on July 23 and August 9, 1982. Three hundred forty-four brook trout from 1.7-13.8 inches in length and 22 rainbow x cutthroat hybrid trout, ranging from 1.5-10.6 inches, were captured. The mottled sculpin was the only non-game species present.

Standing crops of brook and rainbow x cutthroat hybrid trout were estimated using a mark-recapture method (Table 2-88). The section supported about 501 trout 3.0 inches and longer, weighing 34 pounds. Brook trout accounted for 96% of the numbers and 91% of the biomass. Fish six inches and longer accounted for 18% of the estimated population. Brook trout condition (length to weight ratio) was above average when compared to other upper Big Hole River tributaries. A BLM district fish habitat survey classified Bear Creek as a productive fishery in excellent condition (BLM, 1980).

Table 2-88. Estimated standing crops of brook and rainbow x cutthroat hybrid trout in a 1,000 ft section of Bear Creek (T2N, R12W, Sec. 34DC) on July 23, 1982. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.0 - 4.4	335	
	4.5 - 6.4	84	
	6.5 - 13.8	<u>64</u>	
		483(±60)	31(±4)
Rainbow x cutthroat hybrid trout	3.0 - 10.6	18(±5)	3(±1)
Total trout		501(±60)	34(±4)

WILDLIFE:

The Bear Creek drainage provides seasonal range for elk from spring through fall and high quality winter range for moose. A good black bear population inhabits the drainage. Other resident wildlife include coyote, beaver, mink, lynx and marten. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional data were collected in a 122 ft riffle sequence located at about stream mile 0.8 (T2N, R12W, Sec. 34DC). Approximately 92% of the total drainage area was located above this site. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 3.8, 11.3 and 33.4 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-81. Lower and upper inflection points occur at about 0.6 and 2.8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.8 cfs (2,027 A.F./yr)

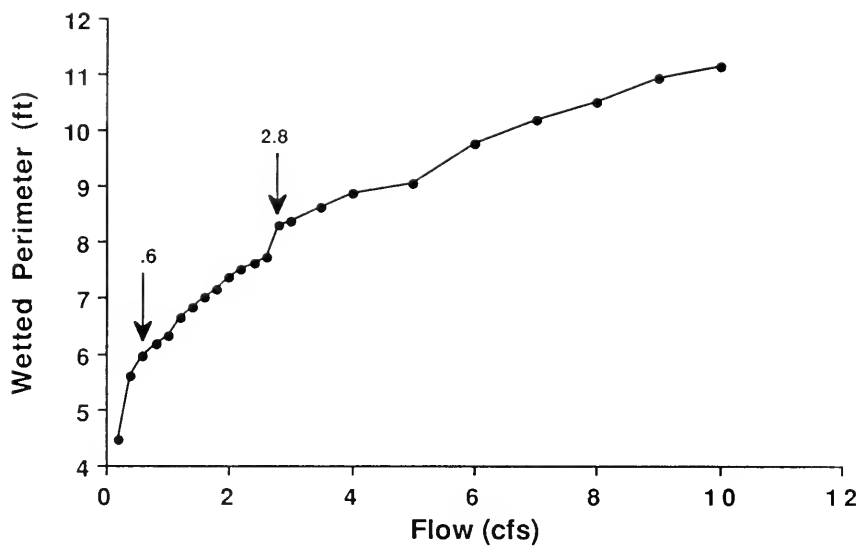


Figure 2-81. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Bear Creek.

STREAM NAME: Bryant Creek

STREAM REACH: From the headwaters to the mouth - 10.0 miles

LOCATION: Sec. 11, T1S, R13W to Sec. 4, T1N, R12W

DESCRIPTION OF STREAM REACH:

Bryant Creek originates in the northeast portion of the Pioneer Mountains of southwest Montana and flows about 10 miles before discharging into the Big Hole River. All of the drainage except for a privately owned quarter section at the stream's mouth is within the Beaverhead National Forest. The drainage area is about 25 square miles.

Bryant Creek is a fairly high gradient (5%) mountain stream that is surrounded by coniferous forest throughout much of its length. Lodgepole pine is the predominate cover within the drainage. The cool, damp riparian zone contains spruce/fir habitats and, along the lower 4 miles of stream, a heavy cover of willow. The lower stream has a cobble-gravel substrate and an average width at low flow of about 15 ft.

Logging is the major land use activity within the drainage. The upper basin receives some livestock grazing. An inactive tungsten mine last operated in 1980-81 is within the drainage.

Access is provided by a USFS road that parallels the length of the creek. Numerous low standard logging roads and jeep trails provide additional access.

GAME FISH PRESENT: Brook trout.

FISHERY:

Two sections of Bryant Creek were electrofished in 1985. A single pass through the 500-ft-long lower section (T1N, R12W, Sec. 8BA) yielded 79 brook trout, ranging in length from 2.2-9.1 inches. Thirty-nine brook trout, ranging from 1.8-7.5 inches, were captured in the 200-ft-long upper section (T1N, R13W, Sec. 25A). Capture efficiency in the upper section was low due to equipment problems. Bryant Creek appears to support a fairly substantial fishery for pan-size brook trout.

On May 8, 1986, a search for rainbow trout redds was conducted on lower Bryant Creek between the Forest Service boundary and mouth. Although there appeared to be an abundance of suitable spawning substrate, no redds were observed. The stream channel braids near the mouth, but does not appear to be impassable to rainbow trout spawners from the Big Hole River. The fact that no redds were located suggests that Bryant Creek is not an important spawning tributary for the river population of rainbow trout.

WILDLIFE:

The Bryant Creek drainage provides spring, summer and fall habitat for mule deer, elk, moose, black bear and mountain lion. In winter, critical range for moose is found within the drainage. Common resident furbearers

include lynx, bobcat, beaver, mink and marten. Marten habitat, in particular, is excellent. Riparian areas are utilized by Franklin's, blue and ruffed grouse. Bryant Creek is too small and precipitous to provide habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a 90 ft section of Bryant Creek at about stream mile 3.6 (Sec. 8ADB, T1N, R12W). Three riffle cross-sections were established; however, one was discarded due to calibration problems. The WETP program was calibrated to field data collected at flows of 3.3, 9.6 and 11.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-82. Lower and upper inflection points occur at approximate flows of 0.8 and 1.4 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.4 cfs (1,014 A.F./yr)

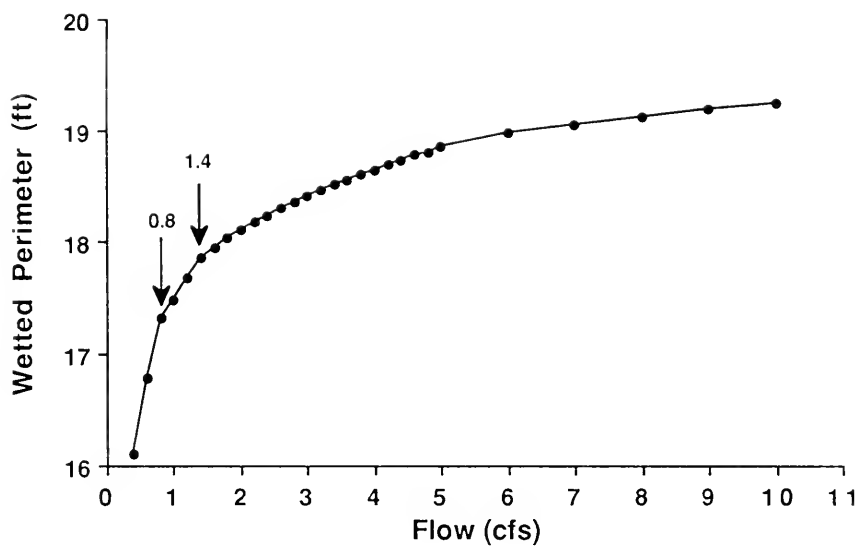


Figure 2-82. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Bryant Creek.

STREAM NAME: Jacobson Creek

STREAM REACH: From Tahepia Lake to the mouth - 8.0 miles

LOCATION: Sec. 20, T3S, R11W to Sec. 33, T3S, R12W

DESCRIPTION OF STREAM REACH:

Jacobson Creek originates in the Pioneer Mountains at Tahepia Lake and flows approximately 8 miles before joining Mono Creek to form the Wise River, a tributary to the Big Hole River. It drains an area of approximately 33 square miles, all within the Beaverhead National Forest.

GAME FISH PRESENT: Cutthroat trout, brook trout, mountain whitefish.

FISHERY:

Two sections of Jacobson Creek at about stream mile 2 and 3 were electrofished in 1987. The lower section (1,000 ft in length) flowed through a willow bottom surrounded by meadows, had a gradient of about one percent, and a streambed comprised of gravel, sand and silt. The upper section (500 ft in length) passed through coniferous forest, had a gradient of about eight percent, a streambed comprised of boulder, cobble and gravel and accumulations of woody debris within the channel.

Game fish captured in the lower section in descending order of abundance were cutthroat trout, brook trout and mountain whitefish. The cutthroat trout appeared to be pure westslopes; however, genetic analyses of cutthroat from Mono Creek, an adjacent drainage, showed them to be hybridized with rainbow trout, suggesting that the Jacobson Creek cutthroat may be hybrids as well.

A population estimate in early July, 1987 in the upper section found 454 cutthroat trout 3.0 inches and longer per mile, with 22 of these 6.0 inches and longer. Captured fish longer than 3.0 inches averaged 4.2 inches in length. The lower portion of the creek appeared to have the potential to support a good population of catchable-size cutthroat trout. A tributary, David Creek, was found to contain several cutthroat longer than 10.0 inches.

WILDLIFE:

Elk and mule deer inhabit the Jacobson Creek drainage from spring through fall while moose are present year-round. Mountain goats are found year-round in the headwaters. Other wildlife inhabitants include black bear, bobcat, mountain lion and mountain grouse.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population, which may include genetically pure westslope cutthroat trout; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Jacobson Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 32% of the average annual flow is being requested for those Big Hole River tributaries having high fishery values. An average annual flow of 42.2 cfs was estimated by the USGS for Jacobson Creek. An instream flow of 14 cfs is, therefore, requested.

STREAM NAME: Wyman Creek

STREAM REACH: From the headwaters to the mouth - 10.6 miles

LOCATION: Sec. 16, T4S, R13W to Sec. 8, T3S, R12W

DESCRIPTION OF STREAM REACH:

Wyman Creek originates in the West Pioneer Mountains and flows approximately 10.6 miles before entering the Wise River, a tributary to the Big Hole River. It drains an area of approximately 35 square miles, all within the Beaverhead National Forest.

GAME FISH PRESENT: Brook trout, cutthroat trout, rainbow trout, rainbow x cutthroat hybrid trout, burbot, mountain whitefish, arctic grayling.

FISHERY:

Two sections of Wyman Creek at about stream mile 2.5 and 3.5 were electrofished in 1986. The lower section (621 ft in length) was surrounded by forest, had a channel gradient of about four percent, contained a moderate amount of woody debris in the channel, had a streambed composed primarily of cobble and boulder, and a width-to-depth ratio of 28:1. The upper section (834 ft in length) passed through an open meadow, had a gradient of less than one percent, a streambed of gravel, sand and silt, and a width-to-depth ratio of 31:1.

Game fish captured in descending order of abundance in the lower section were brook trout, rainbow trout, rainbow x cutthroat hybrid trout, burbot, and mountain whitefish. Brook trout, cutthroat trout, rainbow trout, hybrids and arctic grayling inhabited the upper section.

Population estimates were made in both sections in July, 1986. The lower section supported about 341 brook trout and 77 rainbow, cutthroat, and hybrids 3.0 inches and longer per mile. About 145 of the brook trout and 17 rainbow, cutthroat and hybrid trout were 6.0 inches and longer. The brook trout averaged 5.3 inches and the Salmo averaged 4.1 inches in length. The upper section supported an estimated 2,425 brook trout 3.0 inches and longer per mile, with 994 of these being 6.0 inches and longer. No estimate was possible for arctic grayling or members of the genus Salmo. Brook trout in this section averaged 5.8 inches, the single grayling captured was 9.1 inches, and the Salmo averaged 7.3 inches.

WILDLIFE:

Elk and mule deer inhabit the Wyman Creek drainage from spring through fall while moose are present year-round. Mountain goats are found year-round in the extreme headwaters. Other resident wildlife of importance include black bear, bobcat and mountain grouse.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid population, which includes arctic grayling - a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 7 cfs (5,068 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Wyman Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 32% of the average annual flow is being requested for those Big Hole River tributaries having high fishery values. An average annual flow of 20.5 cfs was estimated by the USGS for Wyman Creek. An instream flow of 7 cfs is, therefore, requested.

STREAM NAME: Pattengail Creek

STREAM REACH: From Sand Lake to the mouth - 17.4 miles

LOCATION: Sec. 36, T2S, R14W to Sec. 11, T2S, R12W

DESCRIPTION OF STREAM REACH:

Pattengail Creek originates at Sand Lake in the Pioneer Mountains of southwest Montana and flows in an easterly direction through a narrow floodplain for 17.4 miles before joining the Wise River, a tributary to the Big Hole River. The stream drains high timbered peaks, scattered alpine meadows and talus slopes. The 70 square mile drainage is owned entirely by the USFS. Major tributaries to Pattengail Creek include Lumbrecht, Reservoir and Lost Horse Creeks. The 45 ft wide channel has an average gradient of 33 ft/1,000 ft. The lower channel is characterized by an extensive network of beaver ponds, dense riparian willow growth and gentle meanders.

The Pattengail Creek drainage is managed by the USFS for grazing, hardrock mining and recreation in the form of hunting, fishing and hiking. The upper drainage is presently under consideration for inclusion in the National Wilderness System as part of the West Pioneers Wilderness Area. The upper drainage has an extensive trail network leading to high alpine lakes and pristine meadows.

In 1901, the Montana Power Company constructed a dam on Pattengail Creek. The purpose of the dam was to regulate flood waters and store water used for power generation at the main river dam at Divide, Montana. The reservoir inundated about 2½ miles of stream habitat. Further damage to the channel occurred when the dam failed in 1927. This caused considerable scouring of the channels of the lower creek and the Wise River. The vertical banks created by this scouring are still noticeable today.

CAME FISH PRESENT: Brook trout, rainbow trout, rainbow x cutthroat hybrid trout, cutthroat trout.

FISHERY:

A 1,000 ft section of Pattengail Creek (T2S, R12W, Sec. 10A) was electrofished on July 10, 1979 and August 4, 1980. A total of 11 brook trout, ranging from 4.0-9.5 inches, and 2 rainbow trout (6.1 and 6.6 inches) were captured. Other species present were longnose sucker, longnose dace and mottled sculpin. Due to the low numbers of fish captured in both years, the standing crop of trout could not be estimated.

Brad Shepard, fishery biologist on the Beaverhead National Forest, electrofished a 500 ft section of Pattengail Creek in T2S, R12W, Sec. 18C on July 16, 1987. Three rainbow trout from 5.7-6.9 inches, one cutthroat trout (6.5 inches) and one hybrid (8.2 inches) were captured.

WILDLIFE:

The Pattengail Creek drainage seasonally supports elk, mule deer and black bear from spring through fall and provides excellent winter range for moose. Marten, mink, lynx and an excellent population of beaver are also present. Blue and spruce grouse are the primary resident game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data were collected in a 137.5 ft riffle-pool sequence located at stream mile 0.5 (T2S, R12W, Sec. 10A). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 22.8 and 111.3 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-83. Lower and upper inflection points occur at about 12 and 44 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 12 cfs (8,688 A.F./yr)

Based on existing electrofishing data, the fishery resource of Pattengail Creek is extremely limited. The flow at the lower inflection point (12 cfs) is, therefore, requested.

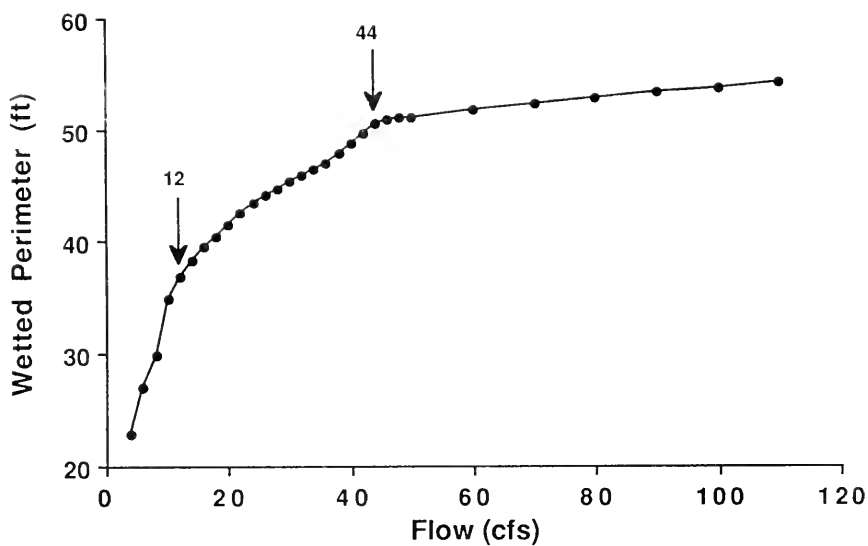


Figure 2-83. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Pattengail Creek.

STREAM NAME: Wise River

STREAM REACH: From the confluence of Mono and Jacobson Creeks to the mouth-
27.9 miles

LOCATION: Sec. 33, T3S, R12W to Sec. 34, T1N, R11W

DESCRIPTION OF STREAM REACH:

The Wise River originates in the Pioneer Mountains of southwest Montana at the confluence of Mono and Jacobson Creeks. The river flows for 27.9 miles in a northerly direction before entering the Big Hole River at the town of Wise River. Steep, timbered mountain sides and talus slopes characterize the upper drainage. In the upper reaches, the river meanders through a densely willowed channel containing numerous beaver ponds. It slowly loses its sinuosity and increases its gradient in the mid-section and again becomes more open along its lower reaches. The channel widens from 20 to 60 ft as distance from its headwaters increases. The gradient averages 8 ft/1,000 ft. Ninety-five percent of the 251 square mile drainage is controlled by the USFS, while private individuals own 4% and the BLM controls the remaining 1%. Of the 50+ streams that drain into the Wise River, major tributaries include Pattengail, Elkhorn, Wyman, Jacobson and Lacy Creeks.

Forest lands within the drainage are used for recreation, cattle grazing, mining, wildlife propagation and logging. Extensive exploration and mining for silver and other metals has occurred throughout the Elkhorn Creek drainage, a headwater tributary to the Wise River. Recreational activities include fishing, hunting, hiking and camping. A paved road parallels and crosses the river, allowing access throughout the drainage. Five USFS campgrounds are located within the basin and opportunities for more primitive recreation are provided by an extensive trail system.

The lower 5 miles of the Wise River are privately owned. Lands surrounding this section are used for hay production. Water from the Wise River is diverted to irrigate these fields. Consequently, severe dewatering occurs in the lower channel, which is reported to be completely dry one out of every three years.

A storage dam on Pattengail Creek, a major tributary to the Wise River, failed in 1927. Damage to the river in the form of scouring and channel relocations is still evident today.

The USGS gaging station at stream mile 9.1 of the Wise River has been operating since 1972. The mean annual flow for a 12-year period of record was 189 cfs. Mean monthly flows ranged from 38.9 cfs (for February) to 904 cfs (for June).

GAME FISH PRESENT: Brook trout, burbot, mountain whitefish, rainbow trout, cutthroat trout.

FISHERY:

A 4,200 ft section of the Wise River below the mouth of Lacy Creek was electrofished on August 5 and 26, 1980. Game fish present in descending order of abundance were brook trout, burbot, mountain whitefish and rainbow trout. Longnose sucker, longnose dace and mottled sculpin were the non-game species captured (Table 2-89).

Table 2-89. Summary of electrofishing survey data collected for a 4,200 ft section of the Wise River (T3S, R12W, Sec. 4) on August 5 and 26, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	69	4.9 - 10.8
Burbot	37	5.5 - 12.0
Mountain whitefish	25	4.5 - 13.7
Rainbow trout	11	4.3 - 13.0
Longnose sucker	-	-
Longnose dace	-	-
Mottled sculpin	-	-

The standing crop of brook trout in the section was estimated using a mark-recapture method (Table 2-90). This section supported about 54 brook trout, weighing 10 pounds, per 1,000 ft of stream. The population is extremely low for a stream of this size.

Table 2-90. Estimated standing crop of brook trout in a 4,200 ft section of the Wise River (T3S, R12W, Sec. 4) on August 5, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	13	
	6.0 - 9.9	36	
	10.0 - 10.8	5	
		54(±24)	10(±5)

The section electrofished is 5 miles below the confluence of Elkhorn Creek. Old tailings along Elkhorn Creek have leached heavy metals and acid effluents into the stream, creating an aquatic desert below the mines. While cutthroat trout have been collected above the mining area, no fish have been found in the 3.5 miles of creek below the mine development (Wipperman, 1969 and Haugen, 1975). These effluents are believed to be depressing fish populations in the upper Wise River as well. Concentrations of dissolved copper and zinc found in Wise River water samples exceed acceptable levels for fish and other aquatic life. Zinc and copper in the sediments from Elkhorn Creek are also deposited throughout the river, possibly affecting fish food production and trout egg survival.

WILDLIFE:

The Wise River drainage provides spring, summer and fall habitat for mule deer, elk, moose, black bear and mountain lion. In winter, excellent range for moose and good range for elk are provided. Resident furbearers include lynx, bobcat, beaver, mink and marten. Marten habitat, in particular, is excellent. Riparian areas are utilized by spruce, blue and ruffed grouse.

WETTED PERIMETER:

Cross-sectional data were collected in a 131 ft section of the Wise River directly below the USGS gaging station (T1S, R12W, Sec. 36C). Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 43.0, 66.1 and 418.5 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-84. Lower and upper inflection points occur at about 20 and 35 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 35 cfs (25,339 A.F./yr)

Results of past and more recent electrofishing surveys indicate that fish populations throughout the entire length of the Wise River are depressed. This could be a result of numerous factors, including angling pressure, metals pollution from Elkhorn Creek, habitat losses and channel alterations resulting from the dam failure in 1927, and the dewatering of the lower 5 miles of river. If these problems were abated, particularly the mine pollution, the fishery of the Wise River could substantially improve. For this reason, the high inflection point flow (35 cfs), although not warranted by the depressed state of existing fish populations, is requested. Should the river be reclaimed in the future, a 35 cfs reservation would help insure that the flow is sufficient to accommodate a potentially expanding trout population.

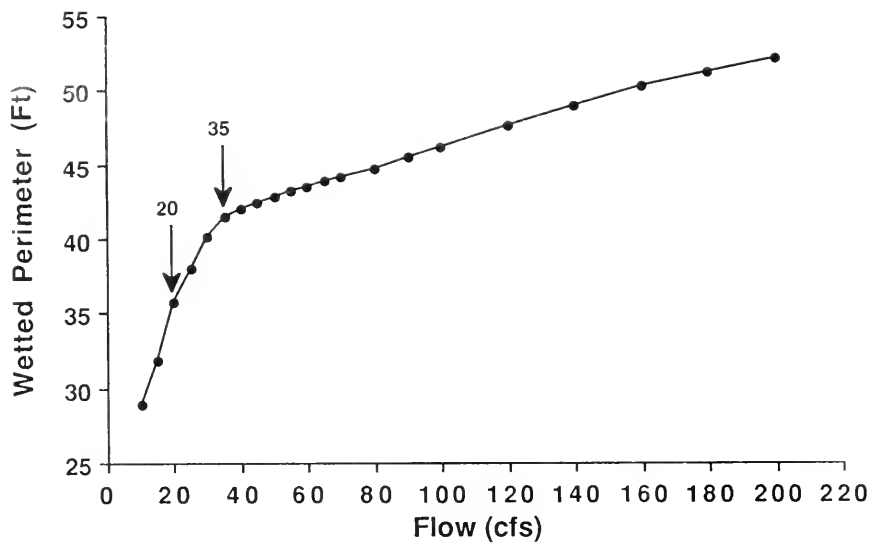


Figure 2-84. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the Wise River.

STREAM NAME: Delano Creek

STREAM REACH: From the headwaters to the mouth - 2.3 miles

LOCATION: Sec. 19, T2N, R10W to Sec. 21, T2N, R10W

DESCRIPTION OF STREAM REACH:

Delano Creek is a small (average width of 4-4½ ft), high gradient, mountain stream that cascades for 2.3 miles through spruce-fir forest lands located entirely within the Beaverhead National Forest before reaching Jerry Creek, a tributary to the Big Hole River. The channel has a substrate of boulders and large cobbles and contains some log debris. Although the drainage was heavily logged in the past, a wide buffer strip was left along Delano Creek, protecting the creek's physical habitat. Livestock grazing is currently the main land use in the drainage.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

Delano Creek supports a trout population comprised solely of westslope cutthroat trout. Electrophoretic analyses conducted by the Genetics Laboratory of the University of Montana have confirmed the population's genetic purity.

Based on a population estimate made in July, 1988 in a 300 ft sample section of Delano Creek (Sec. 20 DA, T2N, R10W), about 134 cutthroat from 3.0 to 5.9 inches and 17 cutthroat 6.0 inches and longer are present per 1,000 ft of stream.

WILDLIFE:

The Delano Creek drainage provides summer range for elk and mule deer. An occasional black bear and mountain lion are also present along with a few marten and bobcat. Blue and spruce grouse are the resident game birds in the area.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 0.3 cfs (217 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Delano Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier in Volume 1. Under this method, 32% of the average annual flow is being requested for those Big Hole River tributaries having high fishery values. An average annual flow of 0.9 cfs was estimated by the USGS for Delano Creek. An instream flow of 0.3 cfs is, therefore, requested.

STREAM NAME: Jerry Creek

STREAM REACH: From the headwaters to the mouth - 12.3 miles

LOCATION: Sec. 18, T2N, R10W to Sec. 36, T1N, R11W

DESCRIPTION OF STREAM REACH:

Jerry Creek drains the Fleecer Mountain Ridge and the Continental Divide near Burnt Mountain in southwest Montana. It flows in a southerly direction for 12.3 miles before entering the Big Hole River below the town of Wise River. Jerry Creek drains an area of about 55 square miles. Ownership of the drainage is shared by the U.S. Forest Service (90%), BLM (5%) and private individuals (5%).

Jerry Creek is a south facing drainage that provides a diversity of habitat for wildlife. The lower drainage is predominately vegetated with willows and interspersions of grass. Cottonwood and aspen are also present and sagebrush is common on the benches along the creek. Stream gradient of Jerry Creek averages 4% and the bottom substrate consists of cobble and gravel. Width of the lower creek at low flow averages 16 feet.

The Jerry Creek drainage has been subjected to mining and logging activities. Grazing allotments occur on Forest Service and BLM lands. Lower Jerry Creek is severely dewatered during the summer to irrigate hay meadows near the stream's mouth.

GAME FISH PRESENT: Rainbow trout, westslope cutthroat trout, brook trout.

FISHERY:

Brad Shepard, fishery biologist on the Beaverhead National Forest, made a population estimate on July 20, 1987 in a section of upper Jerry Creek (Sec. 33C, T2N, R10W) at about stream mile 8. The upper creek supported an estimated 3.4 pounds of westslope cutthroat trout and 3.0 pounds of brook trout per 1,000 ft.

On May 8, 1976, a rainbow trout redd survey was conducted on Jerry Creek between the Forest Service road #83 bridge (T1N, R10W, Sec. 30C) and the mouth, a distance of about 1.5 miles. Seventeen definite and 11 probable redds were identified, the majority being located in the lower ½ mile of Jerry Creek. Beaver dams in the lower mile of stream may serve as partial barriers to fish migration.

Another redd survey was conducted on May 8, 1987. Six rainbow trout redds as well as 5 adult spawners were observed, indicating that spawning apparently occurred later in 1987 than in 1986. The furthest upstream redd was located about 3 miles above the mouth.

Based on the results of these redd surveys, lower Jerry Creek appears to be an important reproductive site for rainbow trout from the Big Hole River. However, because the lower stream is severely dewatered during the summer irrigation season, nursery habitat for rainbow trout may be limited, thus

impacting the stream's capacity to contribute young recruits to the Big Hole fishery.

WILDLIFE:

The Jerry Creek drainage provides spring, summer and fall habitat for mule deer, white-tailed deer, elk, moose, black bear and mountain lion. In winter, important range for deer and elk and critical range for moose are provided. Furbearers present include mink, marten, beaver, Canada lynx and bobcat. Bobcats, in particular, are abundant. Boreal owls are known to inhabit the area in the winter and probably nest in the drainage. No threatened or endangered species are known to inhabit the drainage.

WETTED PERIMETER:

Cross-sectional measurements were made in a 420 ft section of Jerry Creek located near the creek's confluence with the Big Hole River (Sec. 36CD, T1N, R11W). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 0.5, 4.8 and 9.9 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-85. Lower and upper inflection points occur at approximate flows of 3 and 7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide spawning and nursery habitats for rainbow trout residing in the Big Hole River; to maintain the existing resident trout population, which includes westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 7 cfs (5,068 A.F./yr)

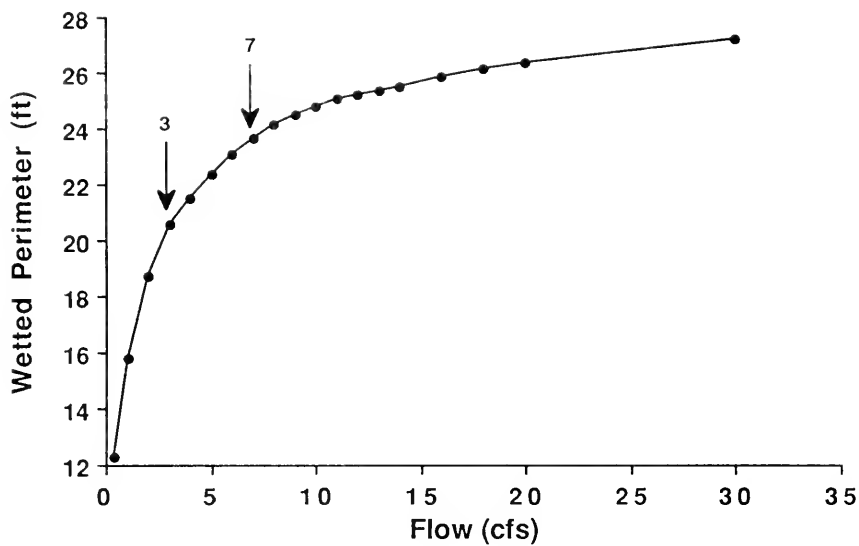


Figure 2-85. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Jerry Creek.

STREAM NAME: Divide Creek

STREAM REACH: From the confluence of its North and East Forks to the mouth-
12.7 miles

LOCATION: Sec. 2, T1N, R9W to Sec. 20, T1S, R9W

DESCRIPTION OF STREAM REACH:

Divide Creek originates at the confluence of its North and East Forks and meanders in a southerly direction for 12.7 miles before entering the Big Hole River near Divide, Montana. Divide Creek is bordered on the east by Highway 15 and the Union Pacific Railroad and on the west by the Butte City Water Aqueduct. The drainage is characterized by sagebrush/grassland covered hillsides and scattered timber. Ownership of the 94 square mile drainage is shared by the USFS (46%), private individuals (37%), MDFWP (6%), State of Montana (5%) and BLM (5%). Although less than half of the drainage area is privately owned, the stream flows entirely through private lands. Average gradient of the 16 ft wide channel is 6 ft/1,000 ft. Lands within the Divide Creek drainage are used for cattle grazing, crop production, wildlife propagation, and recreation in the form of hunting and fishing.

Livestock grazing within the riparian zone along stretches of Divide Creek has damaged fishery habitat. Trampled banks, loss of vegetative bank cover and increased soil erosion characterize these stretches. The diversion of natural flows for irrigation coupled with increased sediment loads resulting from bank instability have caused silt to be deposited in riffle and spawning areas.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Divide Creek was electrofished on July 10 and August 1, 1979. Two hundred ninety-eight brook trout, ranging from 1.5-11.0 inches, and 27 rainbow trout from 4.5-10.5 inches were captured. The mottled sculpin and longnose sucker were the non-game species collected.

The standing crop of trout was estimated using a mark-recapture method (Table 2-91). This 1,000 ft section supported about 370 trout, weighing 43 pounds. Brook trout, the predominant species, comprised 87% of the total numbers and 84% of the biomass. Deep Creek supports an excellent fishery for a stream of its size and is one of the more popular brook trout fisheries in the Big Hole drainage.

Table 2-91. Estimated standing crop of trout in a 1,000 ft section of Divide Creek (T1N, R9W, Sec. 28D) on July 10, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	177	
	6.0 - 9.9	144	
	10.0 - 11.0	<u>2</u>	
		323(±69)	36(±7)
Rainbow trout	4.5 - 5.9	28	
	6.0 - 9.9	16	
	10.0 - 10.5	<u>3</u>	
		47(±18)	7(±3)
Total trout		370(±71)	43(±8)

WILDLIFE:

The Divide Creek drainage provides excellent winter range for moose, mule deer and elk. Spring through fall populations of deer, elk and black bear are rated as good. Some lynx and good populations of beaver, mink and marten are present. Blue and spruce grouse are the primary game birds inhabiting the drainage.

WETTED PERIMETER:

Cross-sectional measurements were made in a 52 ft riffle-pool sequence in T1N, R9W, Sec. 28D. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 3.0 and 12.2 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-86. Lower and upper inflection points occur at about 1.6 and 3.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3 cfs (2,172 A.F./yr)

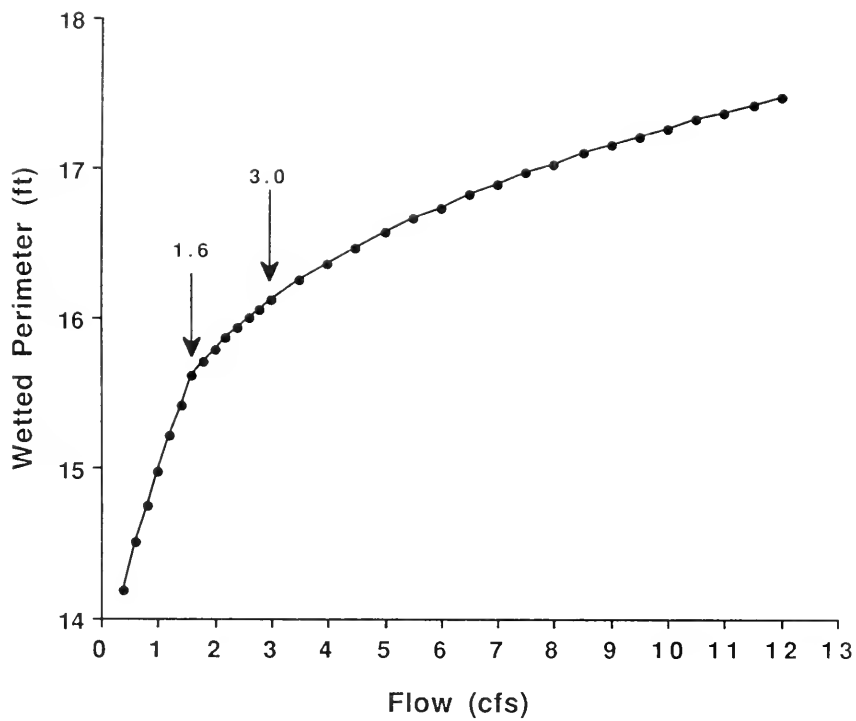


Figure 2-86. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Divide Creek.

STREAM NAME: Canyon Creek

STREAM REACH: From Canyon Lake to the mouth - 17.7 miles

LOCATION: Sec. 8, T3S, R11W to Sec. 32, T1S, R9W

DESCRIPTION OF STREAM REACH:

Canyon Creek originates at Canyon Lake in the Pioneer Mountains of southwest Montana. The stream flows in a northeasterly direction for 17.7 miles before entering the Big Hole River. For the majority of its length, Canyon Creek cascades through a forested canyon containing numerous limestone caves. It flows through cottonwood and willow bottoms in its lower few miles. The stream gradient averages 36 ft/1,000 ft. Ownership of the 51 square mile drainage is shared by the USFS (97%), BLM (2%) and private landowners (1%). The only named perennial tributaries are Lion and Vipond Creeks. Numerous high mountain lakes dot the headwater area. The substrate within the 12 ft wide channel is composed primarily of gravel and rubble.

Lands within the Canyon Creek drainage are used for cattle grazing, mining and recreational activities, including fishing, hunting and camping. An improved gravel road, which parallels the lower 12 miles of stream, ends at a USFS campground. A guest ranch is located along the stream.

The aquatic resource of Canyon Creek is relatively unaffected by man's activities. Minor losses of riparian habitat and undercut banks have occurred on several isolated sections of the stream. Although the headwater area was extensively mined and left unreclaimed and toxic metals may be leaching into the stream, their effect on the aquatic resource appears negligible.

GAME FISH PRESENT: Rainbow trout, rainbow x cutthroat hybrid trout, brook trout.

FISHERY:

A 1,000 ft section of Canyon Creek was electrofished on July 9 and 31, 1979. Ninety-two rainbow and rainbow x cutthroat hybrid trout, ranging from 2.6-12.7 inches, and 64 brook trout from 4.0-11.7 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout in the section was estimated using a mark-recapture method (Table 2-92). This 1,000 ft section supported about 211 trout 4.0 inches and longer, weighing 27 pounds. Rainbow trout and rainbow x cutthroat hybrids were the predominant game fish, comprising about 54% of the total trout numbers and 59% of the biomass.

Table 2-92. Estimated standing crop of trout in a 1,000 ft section of Canyon Creek (T2S, R10W, Sec. 15A) on July 9, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout and rainbow x cutthroat hybrids	4.0 - 5.9	43	
	6.0 - 9.9	64	
	10.0 - 12.7	<u>6</u>	
		113(±29)	16(±4)
Brook trout	4.0 - 5.9	59	
	6.0 - 9.9	36	
	10.0 - 11.7	<u>3</u>	
		98(±28)	11(±2)
Total trout		211(±40)	27(±5)

WILDLIFE:

The Canyon Creek drainage supports year-round populations of mule deer, elk, mountain goat and bighorn sheep. Some winter range for moose is also provided. The drainage is particularly noted for providing good habitat for bobcat and mountain lion. Blue and spruce grouse are the primary upland game birds within the drainage.

WETTED PERIMETER:

Cross-sectional measurements were collected in a 96 ft riffle-pool sequence in T2S, R10W, Sec. 12A. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 4.2, 15.3 and 48.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-87. Lower and upper inflection points occur at 3 and 5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident fish populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

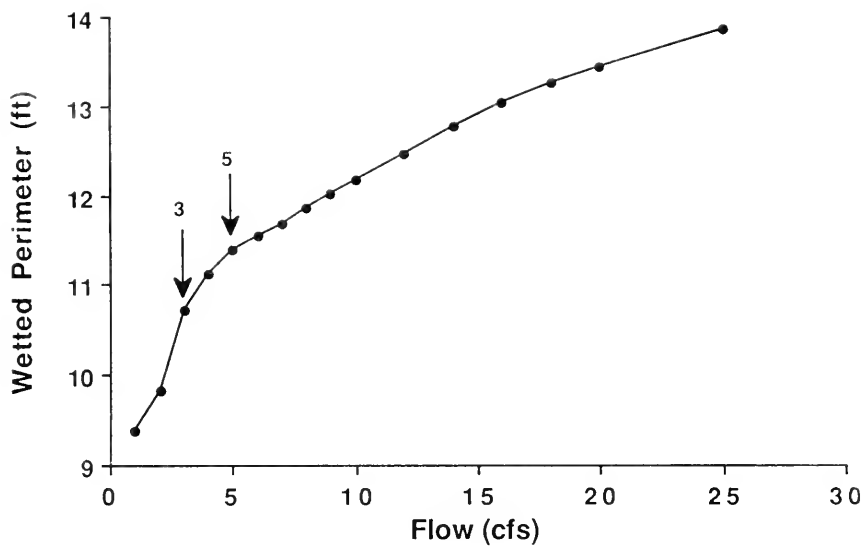


Figure 2-87. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Canyon Creek.

STREAM NAME: Moose Creek

STREAM REACH: From the headwaters to the mouth - 16.0 miles

LOCATION: Sec. 8, T1S, R7W to Sec. 32, T1S, R9W

DESCRIPTION OF STREAM REACH:

Moose Creek originates on the eastern slope of the Highland Mountains of southwest Montana and flows in a southwesterly direction for 16 miles before entering the Big Hole River, 10 miles north of Melrose. Moose Creek flows through a riparian zone of willows, alder, aspen, grasses and forbs. The average gradient of the 13 ft wide channel is approximately 40 ft per 1,000 ft. Ninety percent of the fan-shaped drainage is forested. The remaining 10% is comprised of sagebrush/grassland hillsides and benches. Control of the 36.4 square mile drainage is shared by the BLM (44%), USFS (43%) and private individuals (13%). Of the portion of the drainage managed by the BLM, 45% lies within the boundaries of the Humbug Spires Primitive Area. Major tributaries to Moose Creek include McLean, Chicken Gulch and the Middle Fork and North Fork Moose Creeks. A gravel road skirting the Humbug Spires Primitive Area provides access to the drainage.

Lands within the Moose Creek drainage are currently used for livestock grazing, hay production, timber harvesting in the upper portion and recreation in the form of hunting, fishing and hiking. During the last century, mining for metals occurred throughout the upper drainage. Approximately 2,000 ft of channel in the upper reaches have been straightened as a result of past placer mining.

The BLM operated a staff and crest-stage gage at approximate stream mile 4.5 of Moose Creek from April through October, 1977 and 1978 (Foggin et al., 1978). Minimum and maximum recorded flows during 1977 were 3.0 cfs in July and 103 cfs in May. Flows during 1978 ranged from a low of 8.6 cfs in August to a high of 122 cfs in May. As with most tributaries to the Big Hole River, the lower reaches of Moose Creek are dewatered during the summer irrigation season.

GAME FISH PRESENT: Rainbow trout, brook trout, cutthroat trout, rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Moose Creek was electrofished on July 2 and 31, 1979. Game fish present in descending order of abundance were rainbow, brook and cutthroat trout and rainbow x cutthroat hybrids. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-93.

Table 2-93. Summary of electrofishing survey data collected for a 1,000 ft section of Moose Creek (T1S, R9W, Sec. 23D) on July 2 and 31, 1979.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	157	1.0 - 11.9
Brook trout	73	1.0 - 11.9
Cutthroat trout	6	5.9 - 8.5
Rainbow x cutthroat hybrid trout	1	9.5
Mottled sculpin	-	-

The standing crop of trout was estimated using a mark-recapture method (Table 2-94). This 1,000 ft section supported about 223 trout 4.0 inches and longer, weighing a total of 27 pounds. Rainbow trout predominated, contributing 61% of the total numbers and 59% of the biomass. Brook trout accounted for about 39% of the numbers and 41% of the biomass. The average condition (length to weight ratio) of the brook trout was greater than that of the rainbow trout. Populations of cutthroat and hybrid trout were too sparse to estimate using the mark-recapture method.

Table 2-94. Estimated standing crop of trout in a 1,000 ft section of Moose Creek (T1S, R9W, Sec. 23D) on July 2, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.0 - 5.9	81	
	6.0 - 9.9	53	
	10.0 - 11.9	3	
		137(±32)	16(±3)
Brook trout	4.0 - 5.9	35	
	6.0 - 9.9	49	
	10.0 - 11.9	2	
		86(±27)	11(±3)
Total trout		223(±42)	27(±4)

WILDLIFE:

The Moose Creek drainage provides good quality winter range for mule deer and elk and excellent winter range for bighorn sheep. The drainage supports a high density elk population in summer and provides some spring through fall habitat for deer and sheep. Other than being an important area for bobcat, use by furbearers is limited. Blue and spruce grouse are the primary upland game birds within the basin.

WETTED PERIMETER:

A 53 ft section of Moose Creek near stream mile 4.5 (T1S, R9W, Sec. 23D) was selected for the collection of cross-sectional data. Five cross-sections describing the riffle-pool sequence were established. The WETP program was calibrated to field data collected at flows of 13.1 and 35.2 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-88. Lower and upper inflection points occur at about 2 and 9 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 9 cfs (6,516 A.F./yr)

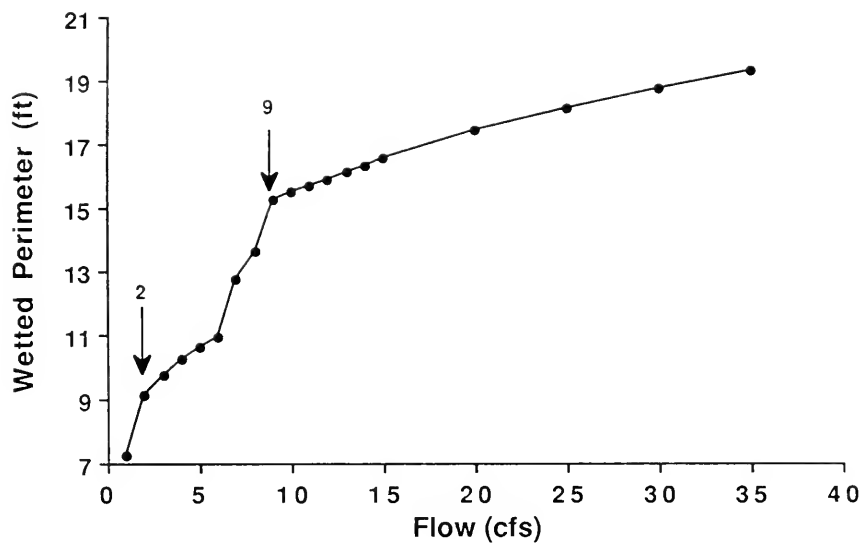


Figure 2-88. The relationship between wetted perimeter and flow for a single riffle cross-section in Moose Creek.

STREAM NAME: Trapper Creek

STREAM REACH: From Trapper Lake to the mouth - 16.7 miles

LOCATION: Sec. 11, T3S, R11W to Sec. 34, T2S, R9W

DESCRIPTION OF STREAM REACH:

Trapper Creek originates at Trapper Lake on the eastern slope of the Pioneer Mountains of southwest Montana. It flows in an easterly direction for 16.7 miles before entering the Big Hole River at Melrose. The stream flows through a narrow canyon having steep, timbered slopes and limestone cliffs. The 45 square mile drainage is controlled by the USFS (63%), private individuals (18%), the BLM (17%) and the State of Montana (2%). There are numerous unnamed intermittent tributaries throughout the drainage. Named tributaries include Sucker, Twomile Gulch, Lockridge Canyon and Sappington Creeks. The 10 ft wide cascading channel has an average gradient of 34 ft/1,000 ft.

Lands within the Trapper Creek drainage are used for recreation in the form of hunting, fishing and hiking, cattle grazing, timber harvesting and, in the lower reaches, hay production. An improved gravel road parallels the stream for its entire length, allowing access to the numerous high mountain lakes in the area.

Historically, the mining and smelting of metals was the major activity in the upper Trapper Creek drainage. Numerous settlements, housing up to 2,000 people, once existed in the upper drainage. The stream presently flows through old tailing piles and unreclaimed mining areas, with possible toxic metals being leached into the stream in the headwaters. Considerable aquatic habitat destruction within the mining area has occurred. The lower stretches of Trapper Creek are diverted for the irrigation of haylands during the summer months. Grazing within the riparian zone has caused bank erosion and the loss of soil stabilizing, vegetative cover along portions of the stream. Noticeable mass wasting has occurred on some outside meanders in Trapper Creek, possibly as a result of road encroachment.

GAME FISH PRESENT: Brook trout, cutthroat x rainbow hybrid trout, rainbow trout, cutthroat trout, brown trout.

FISHERY:

A 1,000 ft section of Trapper Creek located 0.25 miles above the USFS boundary was electrofished on August 4 and 28, 1980. Game fish present in descending order of abundance were brook trout, cutthroat x rainbow hybrid trout, rainbow trout, cutthroat trout and brown trout. The mottled sculpin was the only non-game species captured (Table 2-95).

Table 2-95. Summary of electrofishing survey data collected for a 1,000 ft section of Trapper Creek (T2S, R10W, Sec. 22D) on August 4 and 28, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	156	2.6 - 8.8
Cutthroat x rainbow hybrids	10	4.0 - 9.8
Rainbow trout	7	2.6 - 9.3
Cutthroat trout	5	7.0 - 11.9
Brown trout	2	6.9 - 7.7
Mottled sculpin	-	-

The standing crop of brook trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-96). This 1,000 ft section supported about 153 brook trout 4.0 inches and longer, weighing 12 pounds. When compared to other streams draining the Pioneer Mountains, Trapper Creek is the only stream where the rainbow trout does not comprise a significant portion of the trout population.

Table 2-96. Estimated standing crop of brook trout in a 1,000 ft section of Trapper Creek (T2S, R10W, Sec. 22D) on August 4, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	121	
	6.0 - 8.8	<u>32</u>	
		153(±27)	12(±2)

Haugen (1975) electrofished two sections of Trapper Creek, totaling 435 ft in length, in 1974. The brook trout was the only species captured in the lower section near the USFS boundary. In the upper section, the cutthroat trout was the only species present. Haugen felt that the abatement of mine pollution in the headwater area was necessary to improve the fishery of Trapper Creek.

WILDLIFE:

The Trapper Creek drainage supports year-round populations of mule deer, elk and mountain goat. Some winter range for moose is also provided. The drainage is particularly noted for providing good habitat for bobcat and

mountain lion. Blue and spruce grouse are the primary upland game birds within the drainage.

WETTED PERIMETER:

A 67 ft section of Trapper Creek just above the USFS boundary (T2S, R10W, Sec. 22C) was selected for the collection of cross-sectional data. The meandering riffle-pool habitat within this section was described using five cross-sections. The WETP program was calibrated to field data collected at flows of 4.8, 18.8 and 24.7 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-89. Lower and upper inflection points occur at about 1.8 and 3.2 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.2 cfs (2,317 A.F./yr)

The fishery of Trapper Creek does not justify a flow recommendation at the upper inflection point. A number of factors appear to be depressing trout populations, the most notable being mine pollution. If these problems were abated, particularly the mine pollution, the fishery could substantially improve. For this reason, the high inflection point flow (3.2 cfs) is requested. Should the creek be reclaimed in the future, a 3.2 cfs reservation would help insure that the flow is sufficient to accommodate a potentially expanding trout population.

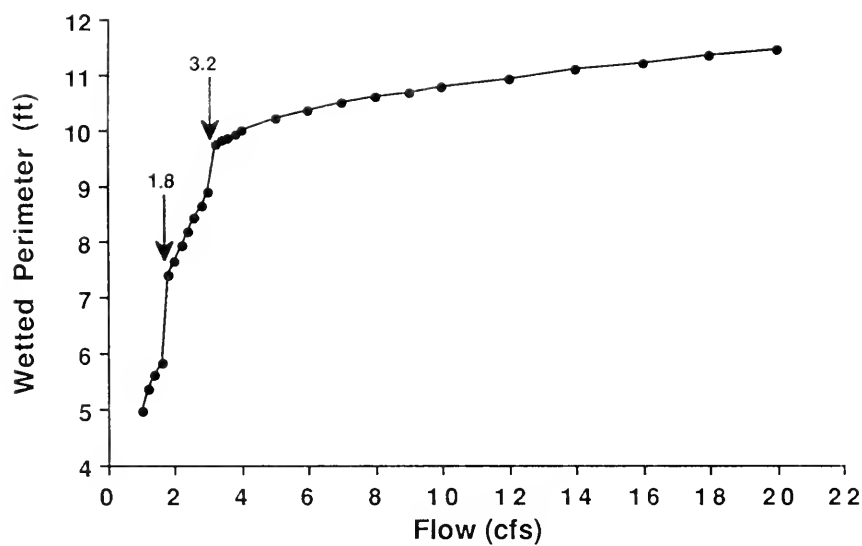


Figure 2-89. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Trapper Creek.

STREAM NAME: Camp Creek

STREAM REACH: From the headwaters to the mouth - 15.6 miles

LOCATION: Sec. 8, T1S, R7W to Sec. 35, T2S, R9W

DESCRIPTION OF STREAM REACH:

Camp Creek originates on the eastern slopes of the Highland Mountains of southwest Montana and flows in a southwesterly direction for 15.6 miles before entering the Big Hole River at the town of Melrose. A small irrigation reservoir is located on Camp Creek at stream mile 3.8. Thirty percent of the drainage is forested, most of which is found in the steep, upper basin. The remainder of the drainage is characterized by sagebrush/grassland benches and a floodplain of dense willows. Control of the 40.5 square mile drainage is shared by the BLM (46%), the USFS (30%), private individuals (20%) and the State of Montana (5%). Major tributaries to Camp Creek include Willow, Wickiup and Little Camp Creeks. Numerous springs also contribute to the flow. Average gradient of the 12 ft wide channel is approximately 50 ft per 1,000 ft.

Lands within the Camp Creek drainage are used primarily for livestock grazing and hay production. Other uses include recreation in the form of hunting and fishing, logging and, historically, mining in the upper drainage. Public access is provided by a gravel road paralleling the stream for its entire length.

During 1977-78, the discharge of Camp Creek was measured at two sites during the snow-free months (Foggin et al., 1978). At the lower site, flows in 1977 varied from a low of 2.4 cfs in September to a high of 19 cfs in mid-April. The maximum annual flow occurred prior to the first measurement. During 1978, flows ranged from 5.0 cfs in September to 90 cfs in May.

The severe dewatering of lower Camp Creek during the summer irrigation season is the most limiting factor to the aquatic resource. Grazing within the riparian zone has resulted in the loss of undercut banks and streamside vegetation and the widening of the channel along portions of the lower stream. Past placer mining in the upper reaches has altered several stretches of the main channel and its tributaries.

GAME FISH PRESENT: Brook trout, rainbow trout, cutthroat trout.

FISHERY:

An 825 ft section of Camp Creek was electrofished on July 8 and 20, 1981. Seventy brook trout, ranging from 4.6-10.4 inches, sixty-one rainbow trout from 4.0-11.8 inches and one 9.3 inch cutthroat trout were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-97). The section supported approximately 208 brook and rainbow trout 5.0 inches and longer, weighing a total of 39 pounds, per 1,000 ft of stream. The brook trout, the predominant trout species, accounted for about

54% of the trout numbers and 46% of the biomass. For a mountain stream of its size, Camp Creek supports a fairly substantial trout population.

Table 2-97. Estimated standing crops of trout in a 825 ft section of Camp Creek (T2S, R8W, Sec. 19A) on July 8, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	21	
	6.0 - 9.9	91	
	10.0 - 10.4	<u>1</u>	
		113(±21)	18(±4)
Rainbow trout	5.0 - 5.9	7	
	6.0 - 9.9	75	
	10.0 - 11.8	<u>13</u>	
		95(±18)	21(±5)
Total trout		208(±28)	39(±6)

WILDLIFE:

The Camp Creek drainage provides good quality winter range for mule deer and elk and excellent winter range for bighorn sheep. Some spring through fall habitat for deer and sheep is also provided. Other than being an important area for bobcat, use by furbearers is limited. Blue and spruce grouse are the primary upland game birds within the drainage.

WETTED PERIMETER:

Cross-sectional data for Camp Creek were collected in a 53 ft riffle-pool sequence at approximate stream mile 2.7 (T2S, R8W, Sec. 19A). Five cross-sections were established. After one set of calibration data were collected (at a flow of 14.2 cfs), the study section was flooded as a result of beaver activity. Consequently, the additional measurements needed to calibrate the WETP computer program could not be collected. However, the Water Surface Profile (WSP) computer program of the Bureau of Reclamation, which requires only one set of calibration data, was used in place of the WETP program to generate the wetted perimeter-flow relationship. The WSP program was calibrated by Rick DeVore of the Bureau of Reclamation, Billings, Montana, using field data supplied by the MDFWP.

The relationship between wetted perimeter and flow for a single riffle cross-section is shown in Figure 2-90. A prominent upper inflection point occurs at about 5 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

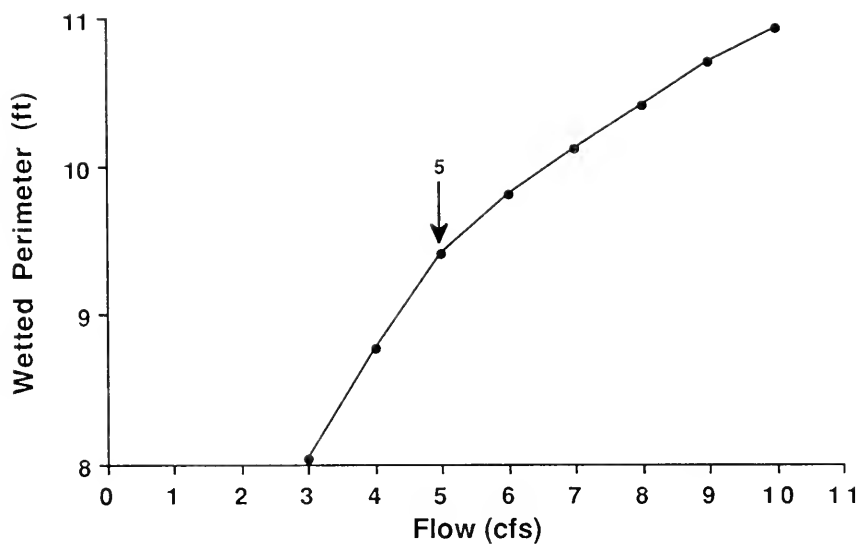


Figure 2-90. The relationship between wetted perimeter and flow for a single riffle cross-section in Camp Creek.

STREAM NAME: Willow Creek

STREAM REACH: From Tendoy Lake to the mouth - 22.5 miles

LOCATION: Sec. 4, T4S, R11W to Sec. 25, T4S, R9W

DESCRIPTION OF STREAM REACH:

Willow Creek originates at Tendoy Lake, a small alpine lake on the eastern slope of the Pioneer Mountains. It flows in an easterly direction for 22.5 miles before entering the Big Hole River approximately 4 miles south of Glen. The upper stream passes through a fan-shaped basin containing numerous alpine lakes and tributaries, then enters a narrow limestone canyon. The lower 4 miles meander through a willow and cottonwood bottom. Mountain slopes are vegetated with lodgepole pine while grass/sagebrush dominates the hillsides of the lower basin. Much of the lower basin has been converted to irrigated hay and grain fields. Major tributaries include Gorge, Buckhorn, Dubois, Bond and North Creeks. Ownership of the 59 square mile drainage is shared between the USFS (80%), the BLM (10%), private individuals (8%) and the State of Montana (2%). The 20 ft wide channel has a fairly steep gradient of 37 ft per 1,000 ft.

Lands within the Willow Creek drainage are used for recreation, cattle grazing and, in the lower reaches, hay production. Gravel roads parallel and cross the stream, providing access throughout the drainage. An extensive trail system leading to numerous alpine lakes exists in the headwater area.

A system of dams and ditches are located on Bond and Deerhead Lakes in the Willow Creek drainage. A ditch diverts these waters into Birch Creek, the adjacent drainage to the south, to be used for irrigation. Ditch failures in this system have caused considerable scouring and vertical bank development in the Willow Creek drainage. Numerous ditches on the lower stream further divert water from the Willow Creek channel, causing severe dewatering during the summer months. Extensive damage to portions of the lower channel has occurred as a result of overgrazing in the riparian zone.

The USGS operated a gage at stream mile 10.7 of Willow Creek from 1962-1966. The mean annual flow for the 4 complete years of record was 20.6 cfs. Mean monthly flows ranged from 6.9 cfs (for March) to 80.6 cfs (for June). Water above the gage site is diverted to an adjacent drainage for irrigation. Thus, flows at this site do not reflect the natural condition.

GAME FISH PRESENT: Rainbow trout, rainbow x cutthroat hybrid trout, brook trout.

FISHERY:

A 1,000 ft section of Willow Creek was electrofished on August 1 and 25, 1980. Ninety-six rainbow and rainbow x cutthroat hybrid trout, ranging from 3.0-12.5 inches, and eighty-three brook trout from 3.7-10.6 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-98). This 1,000 ft section supported about 238 trout, weighing 33

pounds. Brook trout accounted for 65% of the trout numbers and 52% of the biomass. The condition of both species was above average for streams surveyed in the Beaverhead National Forest. Large pools and excellent instream and overhanging cover contributed to the healthy fishery in this section of stream.

Table 2-98. Estimated standing crop of trout in a 1,000 ft section of Willow Creek (T4S, R10W, Sec. 34A) on August 1, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.7 - 5.9	85	
	6.0 - 9.9	68	
	10.0 - 10.6	<u>1</u>	
		154(±47)	17(±4)
Rainbow trout and rainbow x cutthroat hybrids	5.0 - 5.9	26	
	6.0 - 9.9	52	
	10.0 - 12.5	<u>6</u>	
		84(±21)	16(±4)
Total trout		238(±52)	33(±6)

WILDLIFE:

The Willow Creek drainage seasonally supports elk from spring through fall and mule deer year-round. The drainage also supports black bear, marten, lynx and excellent populations of bobcat and mountain lion. Blue and spruce grouse are the primary resident game birds.

WETTED PERIMETER:

Cross-sectional data were collected in a 68 ft section of Willow Creek (T4S, R10W, Sec. 34B) 0.5 mile above the USGS gage station. Five cross-sections describing the riffle-pool habitat were established. The WETP program was calibrated to field data collected at flows of 9.3, 43.8 and 59.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-91. Lower and upper inflection points occur at about 7 and 16 cfs, respectively.

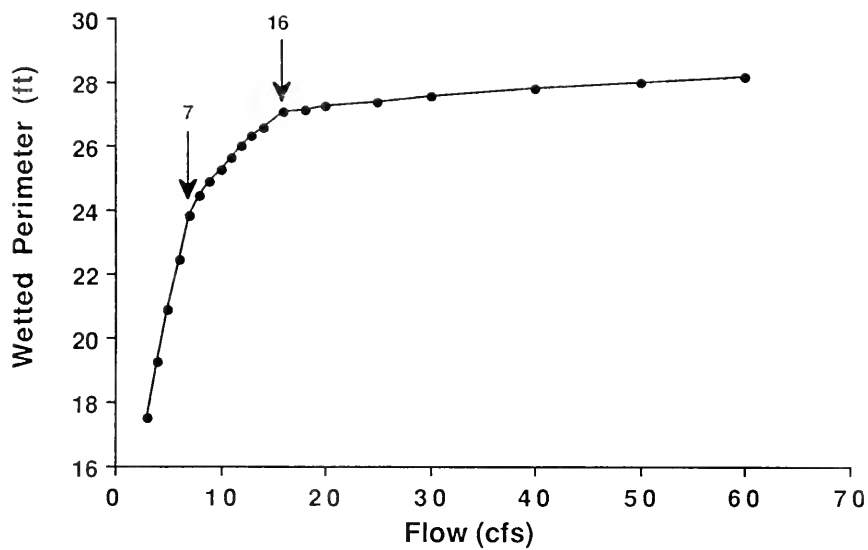


Figure 2-91. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Willow Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 16 cfs (11,583 A.F./yr)

STREAM NAME: Birch Creek

STREAM REACH: From the confluence of Mule Creek to the mouth - 20.3 miles

LOCATION: Sec. 2, T5S, R11W to Sec. 31, T4S, R8W

DESCRIPTION OF STREAM REACH:

Birch Creek originates in the West Pioneer Mountain Range of southwest Montana and flows in an easterly direction for about 22 miles before entering the Big Hole River near the town of Glen. The 48 square mile drainage is controlled by the USFS (73%), private individuals (18%), BLM (7%) and the State of Montana (2%). The average gradient of the 20 ft wide channel is approximately 43 ft/1,000 ft. The portion of the drainage on USFS lands is characterized by steeply timbered slopes and a narrow floodplain. After leaving USFS lands, the vegetative cover consists of sagebrush and grassland communities with much of the land converted to irrigated hay pastures. The riparian zone is composed primarily of willow, birch, aspen, alder, grasses and forbs. Major tributaries include Thief, Sheep and Mule Creeks. Alpine lakes dot the headwater area.

Lands within the Birch Creek drainage are used for mining, cattle grazing, hay and grain production and recreation in the form of fishing, hunting, camping and hiking. A gravel road parallels the creek, becoming a jeep trail along the upper reaches of the stream. There are two USFS campgrounds, a picnic area and the opportunity for extensive hiking within the scenic drainage.

Present mining activity within the drainage is limited to scattered patented claims and small operations. In the past, the Birch Creek drainage was a major producer of metals.

The major use of the water in the Birch Creek drainage after leaving USFS lands is for the irrigation of hay and grain crops. Privately owned irrigation companies have constructed dams on the outlets of Deerhead, Pear, Anchor, Tub, Boot and May Lakes. Birch Creek is used as a means for conveying water 10-15 miles from these alpine lakes into a series of irrigation ditches and pipes. Considerable damage to the Birch Creek channel has occurred as a result of dam failures on these numerous lakes. This has produced a scoured channel, a reduction in instream cover due to extensive bedload movement, and loss of bank vegetation. Fish habitat in the form of pools and other resting and holding areas is lacking. Because of the extensive irrigation network below the USFS boundary, the natural channel is severely dewatered in the lower 8 miles during the summer irrigation season.

A USGS gage station was operated at stream mile 11.0 of Birch Creek between 1946 and 1976. The mean annual flow for the 28-year period of record was 29.4 cfs. Mean monthly flows ranged from 7.3 cfs (for February) to 117 cfs (for June).

GAME FISH PRESENT: Brook trout.

FISHERY:

Considerable time and effort was expended in locating a 1,000 ft section of Birch Creek with good cover and riffle-pool development. Two electro-fishing passes through the section (T5S, R11W, Sec. 1A) were completed on August 1, 1980. Cover and other likely fish habitat were thoroughly worked. Twelve brook trout, ranging from 3.6-6.4 inches, were captured. Mottled sculpins were also present. Based on this survey, the trout population of Birch Creek appears to be extremely sparse. This may be a result of a number of factors, including elevated metals concentrations, excessive flow fluctuations that occur throughout the year, and inadequate resting habitat and instream cover.

WILDLIFE:

The Birch Creek drainage supports mule deer and elk year-round, providing high quality winter range for both species. The drainage also supports black bear, marten, lynx and excellent populations of bobcat and mountain lion. Blue and spruce grouse are the primary resident game birds.

WETTED PERIMETER:

Cross-sectional data were collected in a 98 ft riffle-run sequence located in T5S, R10W, Sec. 23B. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 17.6, 85.4 and 161.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-92. Lower and upper inflection points occur at 10 and 18 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

Due to the depressed trout population and degraded state of the stream channel of Birch Creek, the flow at the low inflection point (10 cfs) is recommended.

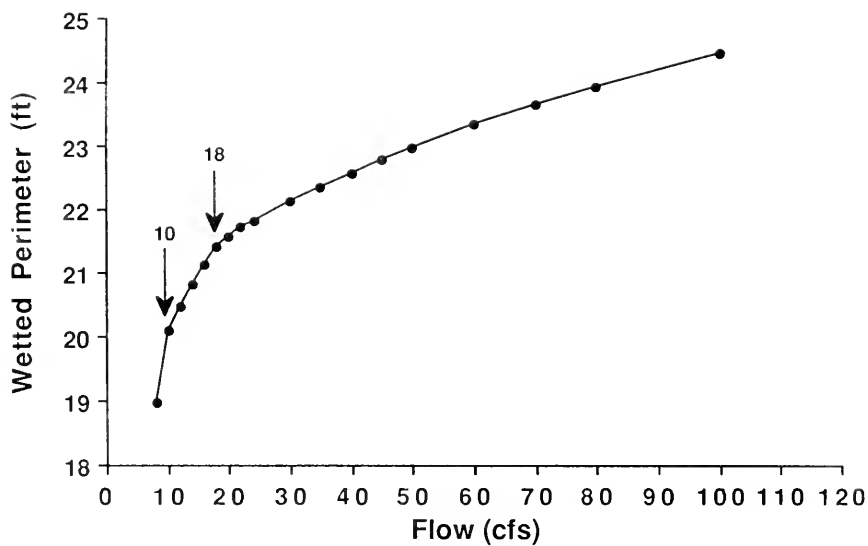


Figure 2-92. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Birch Creek.

JEFFERSON RIVER SUB-BASIN

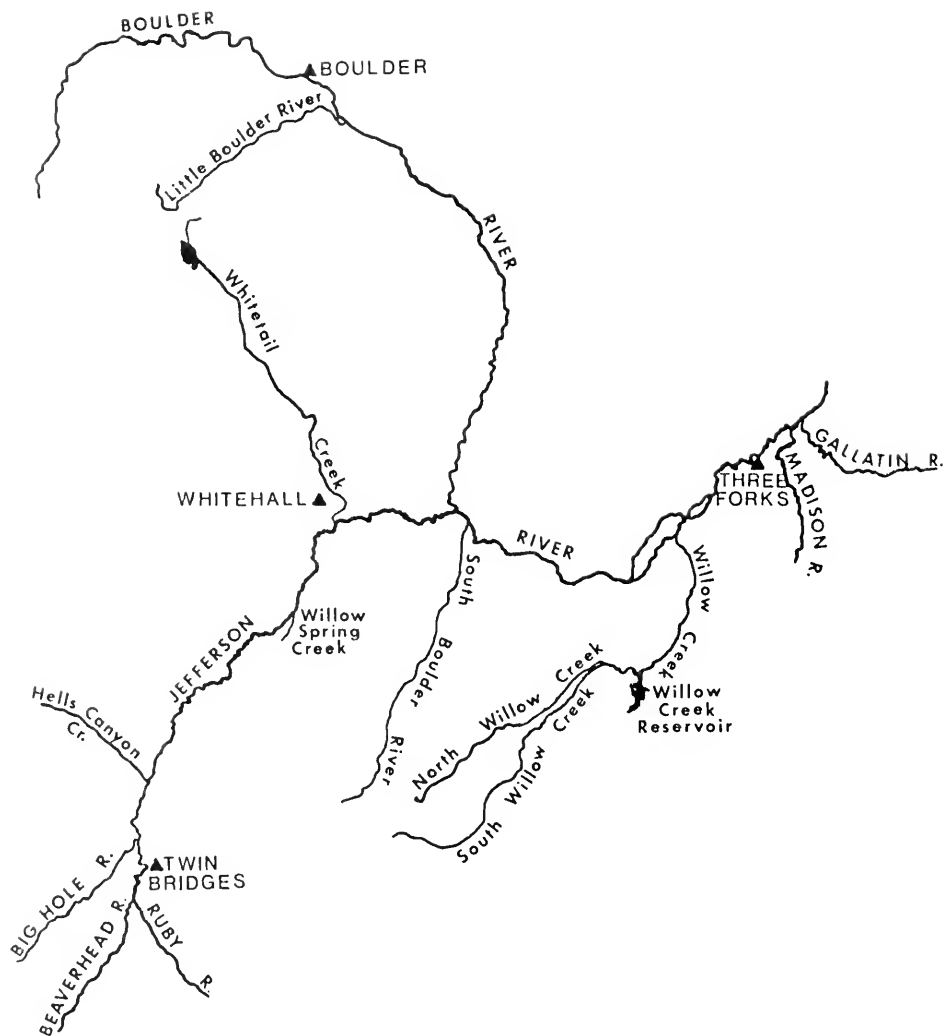


Figure 2-93. Map of the Jefferson River Sub-Basin.

STREAM NAME: Jefferson River

STREAM REACH: From the headwaters to the confluence of the Madison River-
84 miles

LOCATION: Sec. 21, T3S, R6W to Sec. 17, T2N, R2E

DESCRIPTION OF STREAM REACH:

The Jefferson River flows for 84 miles from its origin at the junction of the Big Hole and Beaverhead rivers to its mouth at Three Forks, Montana, where it joins the Madison and Gallatin rivers to form the Missouri River. The average width of the river is about 197 ft. The gradient averages 7.3 ft per mile and sinuosity is 1.6. The bottom substrate is primarily gravel-cobble. Heavy depositions of silt occur at some main river sites and in many side channels.

Much of the Jefferson River is braided, particularly in the area of Three Forks where many islands and side channels occur. During the irrigation season, virtually all of the tributaries to the Jefferson are diverted before reaching the river. The Boulder River is the only tributary to contribute a significant volume of flow during the high water period.

The natural tendency of the river to migrate within its floodplain affects agricultural lands, pastures, homesites, bridges and irrigation diversions. Various methods to stabilize the channel and protect the floodplain development have been tried. Many of these projects, especially those which block high water channels, have aggravated the instability problem. Many projects have also increased sedimentation and removed overhanging bank vegetation, both detrimental to the aquatic resource. A survey in 1973 showed about 10% of the Jefferson River had "man caused" channel alterations (Peterson 1973).

Between May, 1983 and April, 1984, fishing pressure for the Jefferson River was estimated in a state-wide mail survey at 27,508 fisherman-days (MDFWP, 1984). Of the 9 major rivers in the upper Missouri drainage of southwest Montana, the Jefferson ranks fourth behind the Madison, Big Hole and Gallatin rivers in total fishing pressure.

In addition to fishing, the Jefferson River provides many other recreational opportunities. Waterfowl hunting, trapping, floating, sight-seeing and asparagus picking are popular activities.

Throughout its length, the Jefferson River is extensively used as a source of irrigation water. In below average water years, portions of the river are severely dewatered. Two irrigation storage reservoirs (Ruby and Clark Canyon Reservoirs) on major upstream tributaries affect the flow pattern of the river.

Long-term USGS gage records for the Jefferson River are available for two sites at river mile 24 and 79. The lower site had a mean annual flow of 2,121 cfs for a 31-year period of record. Mean monthly flows ranged from 751 cfs (for August) to 5,790 cfs (for June). Base winter flow was 1,180 cfs. The upper gage site (near the headwaters) had a mean annual flow of 2,014 cfs

for an 18-year period of record. Mean monthly flows ranged from 856 cfs (for August) to 6,050 (for June). Base winter flow was 1,070 cfs. Flows at both these gages reflect the severe dewatering that occurs during most summer irrigation seasons, thus making August the lowest flow month of the year.

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, brook trout, largemouth bass.

FISHERY:

The Jefferson River provides a good spring and fall brown trout fishery that is popular with local residents of the Butte-Whitehall area. Brown trout in the 1½-2 pound class are common, with trout in excess of 5 pounds taken annually. Rainbow trout are also present, but comprise less than 10% of the trout population. Other species found in the Jefferson River and their relative abundance are:

Mountain whitefish	abundant
Longnose sucker	abundant
White sucker	abundant
Carp	common
Mountain sucker	uncommon
Longnose dace	uncommon
Flathead chub	uncommon
Mottled sculpin	uncommon
Golden shiner	rare
Stonecat	rare
Yellow perch	rare
Black crappie	rare
Largemouth bass	rare
Brook trout	rare

Population estimates conducted in a 7-mile long section of the lower Jefferson River since 1979 show that the numbers of 3-year and older brown trout (about 12 inches and longer) have varied annually between 226 and 452 per mile. Trout biomass estimates have ranged from 202 to 518 pounds per mile.

The upper Jefferson River above the major irrigation diversions supports a somewhat greater trout population. Over a three-year period, estimated numbers of 3-year and older brown trout ranged from 253 to 503 per mile and biomass estimates varied between 318 and 535 pounds per mile for a 3.1-mile-long study section.

A number of environmental factors are responsible for the overall depressed trout populations of the Jefferson River, the most notable being the severe dewatering that occurs during most irrigation seasons in various river segments. Given adequate summer flows, the river is capable of supporting a greater biomass of trout.

WILDLIFE:

The riparian habitat along the Jefferson River is extensive due to the many river meanders. This habitat supports excellent populations of furbearers, including beaver, mink and river otter. Both mule and white-tailed deer inhabit the river bottom year-round. Other resident big game species include an occasional moose and black bear. Bald eagles winter along the river. Great blue heron rookeries are located near Cardwell.

Waterfowl commonly breed within the Jefferson River valley. Substantial numbers of Canada geese nest on islands between Cardwell and Waterloo. Duck production is excellent in the many sloughs along the river. Various waterfowl, including swans, visit the area during migration. Goldeneyes and mergansers are common winter residents.

WETTED PERIMETER:

Cross-sectional measurements for use in the wetted perimeter inflection point method were made in a section of the lower Jefferson River near Three Forks. The WETP program was calibrated to field data collected at flows of 1,015, 2,385 and 7,350 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross-sections (Figure 2-94) shows lower and upper inflection points at flows of about 550 and 1,100 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1,100 cfs (796,363 A.F./yr)

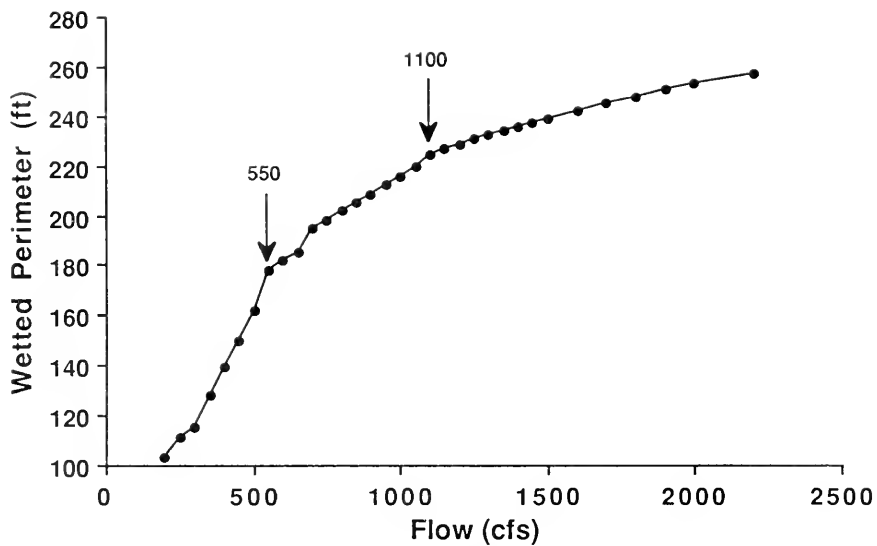


Figure 2-94. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in the Jefferson River.

STREAM NAME: Hells Canyon Creek

STREAM REACH: From the headwaters to the mouth - 10.5 miles

LOCATION: Sec. 34, T1S, R7W to Sec. 34, T2S, R6W

DESCRIPTION OF STREAM REACH:

Hells Canyon Creek arises in the Highland Mountains of southwest Montana and flows in a southeasterly direction for 10.5 miles before discharging into the Jefferson River near the town of Twin Bridges. The upper stream passes through open, mountain terrain containing scattered stands of timber, while the lower portion flows through a dry, steep, rocky canyon having a narrow band of riparian vegetation. Stream width averages about 12.3 ft. Except for the lower $\frac{1}{2}$ mile of stream which is privately owned, Hells Canyon Creek is surrounded by public lands controlled by the BLM and USFS (Deerlodge National Forest). A gravel road provides access to the headwaters where a USFS station is located.

In addition to recreation, other land uses in the drainage include logging and livestock grazing. A number of mining claims are filed along the lower $\frac{1}{2}$ mile of creek. In the past, portions of the lower creek have been placer mined. A single headgate diverts irrigation water from the lower end of the creek.

GAME FISH PRESENT: Rainbow trout, rainbow X cutthroat hybrid trout, brown trout, brook trout.

FISHERY:

A 1,000 ft section of upper Hells Canyon Creek was electrofished on September 25 and November 16, 1981. One hundred ninety-eight rainbow and rainbow X cutthroat hybrid trout from 2.0-9.4 inches in length were captured. No other species were present.

The standing crop of trout in the section was estimated using a mark-recapture method (Table 2-99). This 1,000 ft section supported an estimated 310 trout 3.5 inches and longer, weighing 21 pounds. For a mountain stream of its size, upper Hells Canyon Creek supports a fairly substantial biomass of trout.

Table 2-99. Estimated standing crop of trout in a 1,000 ft section of Hells Canyon Creek (T2S, R7W, Sec. 12) on September 25, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow and rainbow X cutthroat hybrid trout	3.5 - 5.9	240	
	6.0 - 9.4	70	
		310(±60)	21(±2)

The lower 600 ft of Hells Canyon Creek at its mouth was electrofished on October 6, 1982. Game fish present were rainbow trout, rainbow X cutthroat hybrid trout, brown trout and brook trout. The mottled sculpin and white sucker were the non-game species captured. The survey data are summarized in Table 2-100.

Table 2-100. Summary of electrofishing survey data collected for a 600 ft section of lower Hells Canyon Creek (T2S, R6W, Sec. 34) on October 6, 1982.

Fish Species	Number Captured	Length Range (inches)
Rainbow and rainbow X cutthroat hybrid trout	44	1.6 - 8.6
Brown trout	17	2.5 - 10.0
Brook trout	4	2.6 - 3.8
White sucker	-	-
Mottled sculpin	-	-

Hells Canyon Creek also provides important spawning and nursery habitats for the rainbow trout population of the Jefferson River. Rainbow trout as large as 5 pounds ascend the lower $\frac{1}{2}$ mile of creek during the spring spawning period. Tagging studies have shown that these fish reside in the Jefferson River as far downstream as Mayflower Bridge - 27 miles below the mouth of Hells Canyon Creek. This is the only tributary to the Jefferson River in which spawning by river rainbow trout has been documented to date and may represent the sole reproductive site for this river population.

WILDLIFE:

The Hells Canyon Creek drainage provides important winter range for mule deer and elk. Other inhabitants include black bear and bobcat. Excellent habitat for bobcat is found within the drainage.

WETTED PERIMETER:

Cross-sectional measurements for Hells Canyon Creek were made in a section of stream in T2S, R7W, Sec. 13A. The WETP program was calibrated to field data collected at flows of 5.7, 7.1 and 13.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections (Figure 2-95) shows lower and upper inflection points at about 2.0 and 3.6 cfs, respectively.

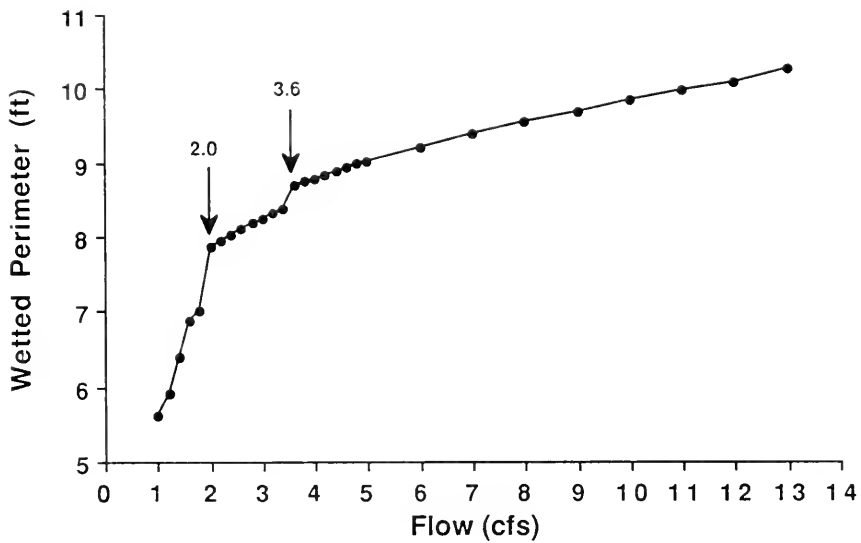


Figure 2-95. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Hells Canyon Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect critical spawning and nursery habitats for rainbow trout residing in the Jefferson River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.6 cfs (2,606 A.F./yr)

STREAM NAME: Willow Spring Creek

STREAM REACH: From the headwaters to the mouth - 1.0 miles

LOCATION: SW, Sec. 13, T1S, R5W to NE, Sec. 13, T1S, R5W

DESCRIPTION OF STREAM REACH:

Willow Spring Creek, a 1.0 mile-long tributary to the Jefferson River, flows from a large spring originating in flat grazing and agricultural land bordering the Jefferson River bottom. Marsh drainage ditches and irrigation returns augment the flow, which averages about 15-20 cfs on the lower stream. Water is pumped from the source to irrigate adjacent fields. A single landowner controls access to the entire stream length.

The upper stream channel is wide, shallow, badly silted and lacking sufficient cover for trout. Trout habitat in the lower stream is somewhat better, the channel narrower and deeper, and the flow swifter. Mats of aquatic vegetation cover much of the stream bottom in summer. Cattle use along the upper stream has left the banks open and eroding. Fencing of the lower stream to exclude cattle has allowed riparian vegetation to recover, stabilizing the banks and improving fish habitat.

GAME FISH PRESENT: Brown trout, brook trout, rainbow trout.

FISHERY:

In 1986, a project to develop Willow Spring Creek as a spawning and rearing tributary for the rainbow trout population of the Jefferson River was initiated by the MDFWP in cooperation with the landowner and Trout Unlimited. Insufficient spawning habitat is believed to be an important factor limiting the abundance of rainbow trout in the river. Under the project, all of the Willow Spring channel was fenced to exclude cattle from the banks, thus allowing riparian vegetation to recover, and the channel was altered in ways that swept silt from the underlying gravel, deepening the channel and creating more and better spawning areas. A run of spawning rainbow trout will be created in the stream by planting wild Jefferson River rainbow trout that originate from eggs collected from spawners that annually ascend Hells Canyon Creek, the only known spawning site for the river population. To date, 8,000 three inchers were planted in October, 1986 and 2,100 yearlings up to 7 inches in June, 1987. Ten thousand young trout raised from eggs collected in 1988 will be planted in Fall, 1988 and Spring, 1989. The plan is to stock for three consecutive years. Planted fish are expected to rear in Willow Spring Creek, move downstream to the Jefferson River to mature to adults, then return to their "natal" stream in 3-5 years to reproduce. The success of these efforts will not be known for a few more years.

Prior to the rainbow trout introductions, brown trout, which range up to 18.3 inches in length, comprised 88% by number and 91% by weight of the resident trout population. Most brown trout were less than 7 inches. Brook trout, none of which exceeded 10 inches, made up the remainder of the population. Overall, Willow Spring Creek prior to the habitat improvements supported an average of 23 pounds of trout per 1,000 ft, which is far less than its biological potential.

WILDLIFE:

Mule and white-tailed deer are year-round residents of the bottom lands adjacent to Willow Spring Creek. Hungarian partridge, sandhill cranes, and an occasional ring-necked pheasant nest along the shores and in adjacent fields. Common furbearers associated with the riparian area include mink, muskrat and beaver. Use of Willow Spring Creek by waterfowl is extensive during the fall and winter months. Common nesting waterfowl are blue-winged teal and mallards.

WHY FLOW IS NECESSARY:

The requested flow is necessary to help ensure the success of the Department's program to develop Willow Spring Creek as a spawning and nursery tributary for the rainbow trout population of the Jefferson River; to maintain the resident trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 9.2 cfs (6,660 A.F./yr)

Willow Spring Creek is spring-fed and not appreciably influenced by snow-melt. Spring creeks receive special consideration in the instream flow program of the MDFWP. Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in Willow Spring Creek remain instream for the maintenance of fish and wildlife habitat.

Flow of Willow Spring Creek near its mouth was measured in Spring, 1983, when the creek was at or near the annual low-flow condition. The measured flow was 9.2 cfs. A later measurement in August, 1988, a period when flow is typically higher due to subsurface irrigation returns, showed 15.0 cfs. Base flow appears to be about 9.2 cfs. A flow of 9.2 cfs is, therefore, requested for the fishery.

STREAM NAME: Halfway Creek

STREAM REACH: Headwaters to canyon - 2 miles

LOCATION: Sec. 2, T3N, R6W to Sec. 13, T3N, R6W

DESCRIPTION OF STREAM REACH:

Halfway Creek originates near Whitetail Peak approximately eight air miles northeast of Butte, Montana, and flows southerly for eight miles before entering Big Pipestone Creek, a tributary to the Jefferson River. All of Halfway Creek is on the Deerlodge National Forest except for a $\frac{1}{4}$ mile segment above the confluence with Big Pipestone Creek, which is located on BLM lands.

Channel gradient in the above-referenced reach is low (0.5-1.0%) and the streambed is mainly composed of sand and gravel. Rock cascades at the downstream boundary of the reach prevent the upstream movement of fish. The grazing of livestock is the main land use activity along this reach.

GAME FISH PRESENT: Westslope cutthroat trout.

FISHERY:

The lower reaches of Halfway Creek support mostly brook trout; however, the reach described above is populated exclusively with westslope cutthroat trout. Electrophoretic analyses performed at the University of Montana Genetics Laboratory found this cutthroat population to be genetically pure.

Electrofishing evaluations conducted in 1986 indicate that the reach supports an estimated 300 cutthroat trout, ranging from six to nine inches in length, per mile of stream.

WILDLIFE:

The drainage contains important elk summer range. Mule deer also inhabit the area along with a few moose. Mountain grouse and black bear are also found in the area.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important habitat for westslope cutthroat trout, a species of "special concern" in Montana; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.9 cfs (1,376 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Halfway Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier in Volume 1. Under this method, 36% of the average annual flow is being requested for those Jefferson River tributaries having high fishery values. An average annual flow of 5.2 cfs was estimated by the USGS for Halfway Creek. An instream flow of 1.9 cfs is, therefore, requested.

STREAM NAME: Whitetail Creek

STREAM REACH: From Whitetail Reservoir to the mouth - 23.7 miles

LOCATION: Sec. 29, T4N, R5W to Sec. 2, T1N, R4W

DESCRIPTION OF STREAM REACH:

Whitetail Creek originates at the outlet of Whitetail Reservoir (elevation 7,249 ft) and flows southeasterly for 23.7 miles before discharging into Jefferson Slough, a branch of the Jefferson River. The stream gradient averages 114 feet per mile. At spring flow levels, Whitetail Creek averages 17.7 feet in width. Approximately 31 percent of the stream is within the boundaries of the Deerlodge National Forest. The flow of Whitetail Creek is regulated by Whitetail Reservoir. Little Whitetail Creek is the major tributary and lesser tributaries include Spring, Grouse, Sage, Wall and Gillispie Creeks. Whitetail Creek drains an area of about 186 square miles.

Existing environmental concerns that are potentially capable of impacting the stream resource include the severe dewatering of the lower reaches during the summer irrigation season, mining activity within the drainage, and bank instability problems.

The USGS operated a gage on Whitetail Creek at stream mile 18.6 from 1949-53, 1955-58 and 1959-68. Winter records are unavailable after 1951. The mean annual flow for the one complete year of record was 19.3 cfs. Mean monthly flows ranged from about 1.4 cfs (for January) to 41.9 cfs (for June). The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the Whitetail Creek drainage at 15,900 acre-feet (22.0 cfs).

GAME FISH PRESENT: Brown trout, rainbow trout.

FISHERY:

A 1,000 ft section of Whitetail Creek was electrofished on September 15 and October 24, 1980. Two hundred fifty-two brown trout, ranging from 4.5-15.4 inches, and 13 rainbow trout from 5.1-12.0 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brown trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-101). This 1,000 ft section supported an estimated population of 318 brown trout 4.5 inches and longer, weighing 107 pounds. The population of rainbow trout was too sparse to estimate using the mark-recapture method. For a stream of its size, Whitetail Creek supports a substantial trout population.

A network of beaver ponds within Whitetail Creek provide essential trout habitat during the winter when the reservoir stores all inflows for release during the irrigation season.

Table 2-101. Estimated standing crop of brown trout in a 1,000 ft section of Whitetail Creek (T3N, R5W, Sec. 25B) on September 15, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	4.5 - 5.9	15	
	6.0 - 9.9	200	
	10.0 - 15.4	<u>103</u>	
		318(±43)	107(±15)

WILDLIFE:

The Whitetail Creek drainage provides year-round habitat for deer, elk, moose and antelope. Black bear and bobcat are other inhabitants. The drainage contains excellent habitat for bobcat.

WETTED PERIMETER:

Cross-sectional measurements for Whitetail Creek were made in a 110 ft riffle-pool sequence located immediately upstream from the forest boundary (T3N, R5W, Sec. 23D). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 4.4, 7.3 and 26.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-96. Lower and upper inflection points occur at approximate flows of 1.4 and 3.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.0 cfs (2,172 A.F./yr)

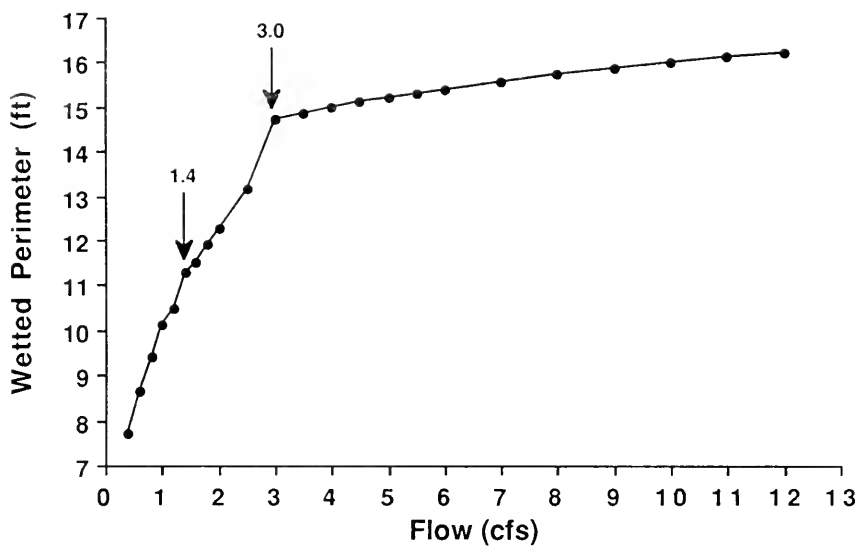


Figure 2-96. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Whitetail Creek.

STREAM NAME: Little Boulder River

STREAM REACH: From the confluence of Moose Creek to the mouth - 9.7 miles

LOCATION: Sec. 28, T5N, R5W to Sec. 10, T5N, R4W

DESCRIPTION OF STREAM REACH:

The Little Boulder River begins near Haystack Mountain on the east slope of the Continental Divide in an area known as Bull Mountain and flows 15.7 miles before discharging into the Boulder River near Boulder, Montana. The stream flows through a deeply incised, narrow canyon through most of its length. The upper 94% of the 58.8 square mile Little Boulder drainage is within the Deerlodge National Forest. Most of the area is densely forested and virtually undisturbed. The lowlands and benches of the lower watershed are used for grazing and hay production. In the past, a portion of the lower watershed (98 acres) was involved in a hydraulic gold mining operation. Access is provided by a gravel road which parallels much of the creek. At spring flow levels, the lower stream averages 17.6 ft in width.

Environmental problems that presently affect the Little Boulder are the severe dewatering that occurs in the lower reaches, bank instability where mining and road building have encroached on the floodplain, and overuse of streamside vegetation by livestock.

The SCS maintained a flow gage on the Little Boulder River from 1963 to 1968. The average annual water yield of the stream was about 15,700 acre-feet (21.7 cfs). Minimum fall and winter flow was about 4 cfs. Farnes and Shafer (1975) estimated the mean annual water yield for the Little Boulder drainage at 12,700 acre-feet (17.5 cfs).

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout.

FISHERY:

A 1,000 ft section of the Little Boulder River at about stream mile 2 was electrofished on July 30 and August 14, 1974. Game fish captured in descending order of abundance were brook, rainbow and brown trout. The electrofishing survey data are summarized in Table 2-102.

Table 2-102. Summary of electrofishing survey data collected for a 1,000 ft section of the Little Boulder River (T5N, R4W, Sec. 9B) on July 30 and August 14, 1974.

Fish Species	Number Captured	Length Range (inches)
Brook trout	45	5.0 - 10.5
Rainbow trout	20	4.2 - 10.7
Brown trout	10	4.3 - 15.9

The standing crop of brook trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-103). This 1,000 ft section supported about 58 brook trout 5.0 inches and longer, weighing 9 pounds.

Table 2-103. Estimated standing crop of brook trout in a 1,000 ft section of the Little Boulder River (T5N, R4W, Sec. 9B) on July 30, 1974. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	5.0 - 5.9	11	
	6.0 - 9.9	46	
	10.0 - 10.9	<u>1</u>	
		58(±12)	9(±2)

The standing crop of trout in a 440 ft section of the Little Boulder River near the mouth was also estimated in 1974 (Vincent, 1975). Game fish captured in descending order of abundance were brown, rainbow and brook trout. The lower stream supported about 141 trout, weighing 57 pounds, per 1,000 ft (Table 2-104). Brown trout, the predominant trout species, accounted for about 55% of the total trout numbers and 60% of the biomass. The lower stream supports a fairly substantial trout population that is characterized by the presence of larger-size brown trout.

Table 2-104. Estimated standing crop of trout in a 440 ft section of the Little Boulder River (T5N, R4W, Sec. 10C) on July 30, 1974. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	4.2 - 23.1	77(±36)	34(±7)
Rainbow trout	5.5 - 14.1	48(±9)	16(±2)
Brook trout	8.0 - 12.1	<u>16(±5)</u>	<u>7(±2)</u>
Total trout		141(±37)	57(±8)

WILDLIFE:

The Little Boulder River drainage supports year-round populations of mule deer and elk. Other wildlife inhabitants include bobcat, beaver, and black bear. Portions of the drainage provide excellent habitat for ruffed grouse.

WETTED PERIMETER:

Cross-sectional measurements for the Little Boulder River were made in a 109 ft riffle-pool sequence located immediately upstream from the forest boundary (T5N, R4W, Sec. 18A). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 9.5, 23.7 and 39.3 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-97. Lower and upper inflection points occur at approximate flows of 3 and 7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 7 cfs (5,068 A.F./yr)

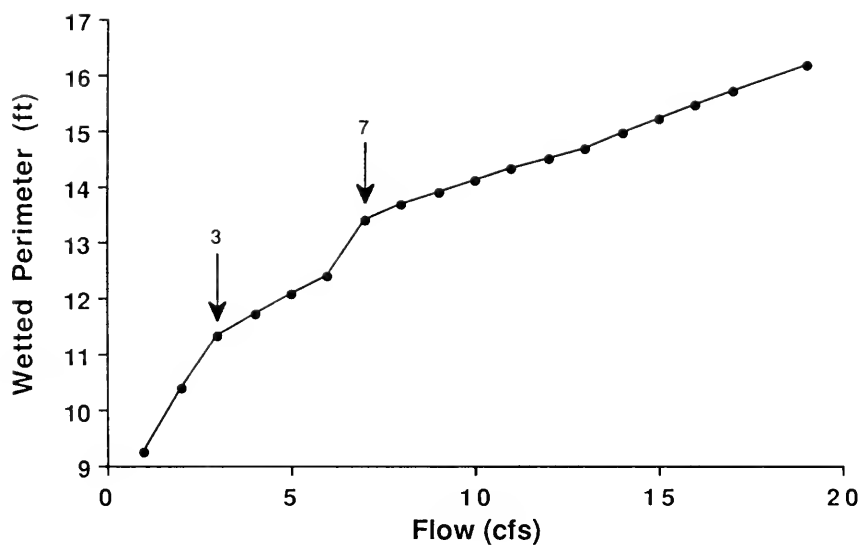


Figure 2-97. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the Little Boulder River.

STREAM NAME: Boulder River

DESCRIPTION OF BASIN:

The Boulder River is formed at the confluence of its South and West Forks (elevation 6740 ft) on the east side of the Continental Divide north of Butte, Montana. It flows east to Boulder, Montana then south to its confluence with the Jefferson River near Cardwell, Montana. It is 78 miles in total length and has a mean gradient of 33.7 ft per mile. At the Deerlodge National Forest boundary above Basin, the stream averages 47.4 ft in width at spring flow levels. Only the upper 26 percent of stream is within the Forest boundary. Major tributaries, in downriver progression, are Lowland, Bison, Basin, Cataract and Muskrat Creeks and the Little Boulder River. The Boulder River drains an area of approximately 763 sq miles.

The river upstream from the Town of Boulder has a narrow floodplain, a high elevation and a steep gradient. Riparian vegetation primarily consists of willows, alders, conifers and, to a lesser extent, cottonwoods and aspens.

The reach of river downstream from the Town of Boulder has a wider floodplain through which the river meanders, a lower elevation and a more gradual gradient. Riparian vegetation primarily consists of cottonwoods, aspens and willows.

Flows in the river depend primarily on snowpack in the mountains, although a number of large springs add to the flow in the lower valley. The major use of water from the Boulder River below the Town of Boulder is for the irrigation of alfalfa and hay meadows. An SCS flow survey in July and August of 1973 showed that four miles of the Boulder River were completely dewatered for irrigation and another 20 miles severely dewatered.

Hard rock mining for metallic minerals in the Boulder River drainage was extensive in the late 1800's and early 1900's. This past mining is still affecting the river below the Town of Basin where heavy metals from acid mine seeps and mill tailings are causing a major water quality problem. Sampling of the sediments in the river channel and floodplain disclosed high concentrations of zinc, copper and lead extending some 25 miles downstream from the source areas (Vincent, 1975). In the river below Basin, Nelson (1976) found depressed standing crops of trout associated with higher metals concentrations in the river. Vincent (1975) partially attributed the low standing crops of trout in the lower Boulder River to metals pollution. Gardner (1977) showed that environmental problems, most notably metals pollution and stream sedimentation, were affecting the distribution and abundance of aquatic insects in the river.

Extensive portions of the Boulder River have been relocated as a result of mining, agricultural and road and railroad building activities. Portions of the upper river channel (Boulder to Bernice) were recently relocated to accommodate Interstate 15. In addition, riprapping of the banks and channel clearance have affected other stretches.

STREAM NAME: Boulder River

STREAM REACH: #1. From the convergence of the West and South Forks to the confluence of High Ore Creek - 25.5 miles

LOCATION: Sec. 12. T5N, R8W to Sec. 22, T6N, R5W

DESCRIPTION OF STREAM REACH:

The 17 miles of the stream-size upper Boulder River above the confluence of Bison Creek meanders through a jungle of overhanging willows. Below Bison Creek, the river enters the Boulder Canyon, passing through the Town of Basin. In the canyon, the river widens, straightens and loses much of the dense bank cover that characterizes the upper river above Bison Creek. The stream gradient steepens and riffle-run areas interspersed with boulders become the common habitat type. The water quality also begins declining due to an influx of toxic metals that begin entering the river at Basin. Below the mouth of High Ore Creek, 4.4 miles downstream from Basin, fish populations become severely depressed.

The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the Boulder River below the confluence of Bison Creek at 48,900 acre-feet (68 cfs).

GAME FISH PRESENT: Rainbow trout, brook trout, mountain whitefish.

FISHERY:

In 1975 and 1976, three 1,316 to 2,900 ft sections of the upper Boulder River between the confluence of Bison and High Ore Creeks were electrofished. The rainbow trout was the predominant game species, followed by mountain whitefish and brook trout. Rainbow trout up to 13.7 inches and brook trout as long as 11.4 inches were captured. Other species present were white sucker, longnose sucker, mottled sculpin and longnose dace. These three sections supported an estimated 22-26 pounds of trout per 1,000 ft of stream.

A 1,050 ft section of the upper Boulder River located upstream from the confluence of Bison Creek was also electrofished in 1976. Game fish captured in descending order of abundance were brook trout, rainbow trout and mountain whitefish. Non-game species were longnose sucker, white sucker and mottled sculpin. The electrofishing survey data are summarized in Table 2-105.

Table 2-105. Summary of electrofishing survey data collected for a 1,050 ft section of the upper Boulder River (T6N, R6W, Sec. 22) on August 5 and 9, 1976.

Fish Species	Number Captured	Length Range (inches)
Brook trout	197	3.2 - 14.8
Rainbow trout	81	4.1 - 10.6
Mountain whitefish	26	7.5 - 16.6
Longnose sucker	127	-
White sucker	11	-
Mottled sculpin	-	-

This section supported about 435 game fish, weighing 75 pounds, per 1,000 ft of stream (Table 2-106). Brook trout and rainbow trout accounted for about 76% (57 pounds) of the total biomass.

Table 2-106. Estimated standing crops of game fish in a 1,050 ft section of the upper Boulder River (T6N, R6W, Sec. 22) on August 5, 1976. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.2 - 14.8	289(±47)	41(±5)
Rainbow trout	4.1 - 10.6	114(±26)	16(±3)
Mountain whitefish	7.5 - 16.6	32(±9)	18(±5)
Total game fish		435(±54)	75(±8)

The higher trout biomass in this upper section (57 pounds per 1,000 ft versus 22-26 pounds for the downstream sections) probably reflects better trout habitat. Large portions of the downstream study sections were straightened as a result of past railway and road construction. Thus, the wide, shallow channel lacks the abundant bank vegetation and undercuts that provide outstanding overhead cover for trout in the unaltered upper section. Declining water quality below the Town of Basin also is a probable contributing factor. When compared to population levels in other reaches of the Boulder River, only the stretch of river near the mouth supported a trout biomass greater than 57 pounds per 1,000 ft of stream.

STREAM NAME: Boulder River

STREAM REACH: #2. From the confluence of High Ore Creek to Cold Spring-
41.9 miles

LOCATION: Sec. 22, T6N, R5W to Sec. 6C and Sec. 7B, T2N, R2W

DESCRIPTION OF STREAM REACH:

Below High Ore Creek, the river flows 5.2 miles to the town of Boulder where it leaves the Boulder Canyon and enters the broad Boulder Valley. Between High Ore Creek and the Cold Spring (the downstream boundary of Reach #2), the aquatic environment can generally be characterized as being severely degraded. Metals pollution, bottom sedimentation, bank and channel alterations, summer irrigation withdrawals, elevated summer water temperatures and a number of other problems all contribute to the poor trout habitat within this reach.

The USGS operated a gage within Reach #2 at stream mile 44.1 of the Boulder River between 1929 and 1972. The mean annual flow for the 41 years of record was 121 cfs. Mean monthly flows ranged from 26 cfs (for January and September) to 493 cfs (for May). Water to irrigate about 3,500 acres is diverted above this site.

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout.

FISHERY:

The brown trout is the predominant game species in the lower 2/3 of Reach #2, with rainbow and brook trout being more common in the upper 1/3. Resident brown trout rarely exceed 18 inches, with the majority less than 11 inches. Rainbow and brook trout can reach lengths of 15 and 12 inches, respectively, although most are in the 8-10 inch class.

Population estimates for four 3,200-12,200 ft long sections of Reach #2 were made in 1974 and 1975. Estimated pounds of trout per 1,000 ft of stream ranged from 6.2-26.6, averaging 15.9 pounds for the four study sections. The trout population is severely depressed, reflecting the numerous environmental problems that impact this reach.

WILDLIFE:

The Boulder River drainage in the vicinity of Reach #2 provides year-round habitat for mule deer, elk, moose and antelope. Black bear are also seasonally present in this area. Furbearers associated with the river and its riparian zone include mink and beaver.

WETTED PERIMETER:

Cross-sectional measurements for Reach #2 of the Boulder River were made in a stream section in Sec. 12D, T4N, R3W. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 18.6, 61.4 and 309.2 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-sections is shown in Figure 2-99. Lower and upper inflection points occur at approximate flows of 8 and 24 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to supply a portion of the water that is required to meet the instream flow need for downstream Reach #3; to dilute mine pollutants; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 24 cfs (17,375 A.F./yr)

The depressed fishery of Reach #2 does not warrant a flow recommendation at the high inflection point on the wetted perimeter-flow curve. However, a high inflection point recommendation is justified by other considerations, the most notable being the instream flow need for downstream Reach #3. The inflow of the Cold Spring helps to rejuvenate the lower river (Reach #3), allowing the trout population to increase significantly. In order to satisfy the flow request for Reach #3, Reach #2 would have to contribute in the neighborhood of 24 cfs or more. Further, flow records for the gage at stream mile 44.1 show that the lowest mean monthly flow for the year (26 cfs) in Reach #2 occurs in January and September. Therefore, a flow of 24 cfs - the high inflection point - would protect much of the base winter flow as well as the present summer low flow, thus preventing any new water users from worsening an already borderline summer flow condition. A flow of 24 cfs is, therefore, requested.

WILDLIFE:

The upper Boulder River drainage along Reach #1 supports year-round populations of mule deer, elk and moose. Black bear are also seasonally present in this area. Furbearers associated with the river and its riparian zone include mink and beaver.

WETTED PERIMETER:

Cross-sectional measurements were made in a 412 ft riffle-pool sequence located immediately above the forest boundary (T6N, R6W, Sec. 24B). Five cross-sections were placed in this section. The WETP program was calibrated to field data collected at flows of 41.0, 68.1 and 206.5 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-98. Lower and upper inflection points occur at approximate flows of 14 and 20 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 20 cfs (14,479 A.F./yr)

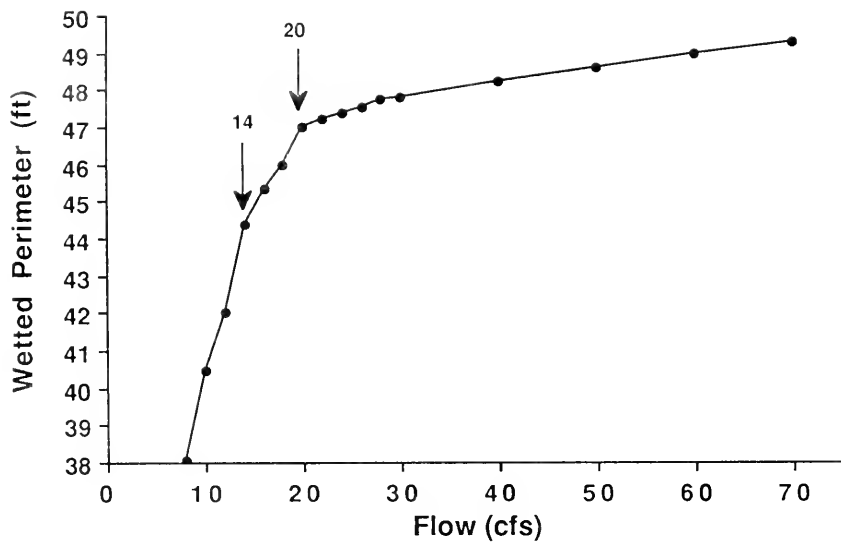


Figure 2-98. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Reach #1 of the Boulder River.

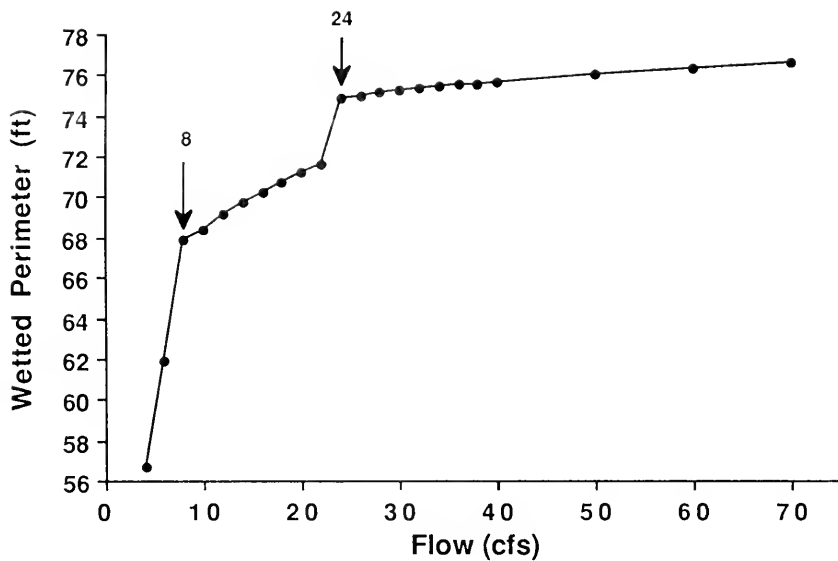


Figure 2-99. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #2 of the Boulder River.

STREAM NAME: Boulder River

STREAM REACH: #3. From the Cold Spring to the mouth - 10.4 miles

LOCATION: Sec. 6C and Sec. 7B, T2N, R2W to Sec. 2, T1N, R3W

DESCRIPTION OF STREAM REACH:

From the Cold Spring the Boulder River flows for 10.4 miles before joining Jefferson Slough, a branch of the Jefferson River. The supplemental flow provided by Cold Spring (about 30 cfs) as well as irrigation return flows help to rejuvenate the lower river and improve habitat for trout. However, other environmental problems, particularly bottom sedimentation, still impact the aquatic resource of Reach #3.

The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the Boulder River at its mouth at 151,500 acre-feet (209 cfs).

GAME FISH PRESENT: Brown trout.

FISHERY:

A 6,150 ft section of Reach #3 was electrofished in 1974. Except for a single brook trout, the brown trout was the only game species captured. A mark-recapture estimate showed that this section supported an estimated 242 age I and older brown trout, weighing 70 pounds, per 1,000 ft of stream. While the population level is significantly higher than that in Reach #2, it is still less than expected for a river the size of the Boulder.

A spawning run of brown trout, some in the 5 pound class, enters the Boulder River each fall. The run is blocked in most years at an irrigation diversion dam at about river mile 2. On October 28, 1977, 216 brown trout, averaging 15.3 inches in length and ranging up to 23.3 inches, were captured by electrofishing in a 200 ft section below the dam. Subsequent tag return data indicated that most of these spawners resided in the lower Jefferson River. Additional tagging studies conducted in later years confirmed this finding.

When considering the magnitude of the sediment deposits that inundate the lower Boulder River and its spawning gravel, the capability of the river to produce young brown trout recruits for the Jefferson River fishery is obviously limited. However, the fact that a significant number of brown trout spawners annually ascend the Boulder - a stream providing only marginal spawning habitat - is indicative of the poor state of other spawning sites for the Jefferson River trout population. The value of the Boulder River as a spawning tributary may, therefore, be greater than previously thought.

WILDLIFE:

The Boulder River drainage in the vicinity of Reach #3 provides year-round habitat for mule deer, elk, moose and antelope. Black bear are also seasonally present in this area. Furbearers associated with the river and its riparian zone include mink and beaver.

WETTED PERIMETER:

Cross-sectional measurements for Reach #3 were made in a stream section in Sec. 13B, T2N, R3W. Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 54.9, 203.1 and 224.2 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section (Figure 2-100) shows lower and upper inflection points at flows of about 25 and 68 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect spawning and nursery habitats for migrant brown trout from the Jefferson River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 47 cfs (34,026 A.F./yr)

An upper inflection point recommendation is not justified for Reach #3 due to the degraded state of the aquatic environment. Neither is a low inflection point recommendation warranted due to the substantial improvement in the trout population level that occurs in this reach, as well as its probable importance as a reproductive site for Jefferson River brown trout. A flow midway between the lower and upper inflection points is a reasonable compromise. A flow of 47 cfs is, therefore, requested.

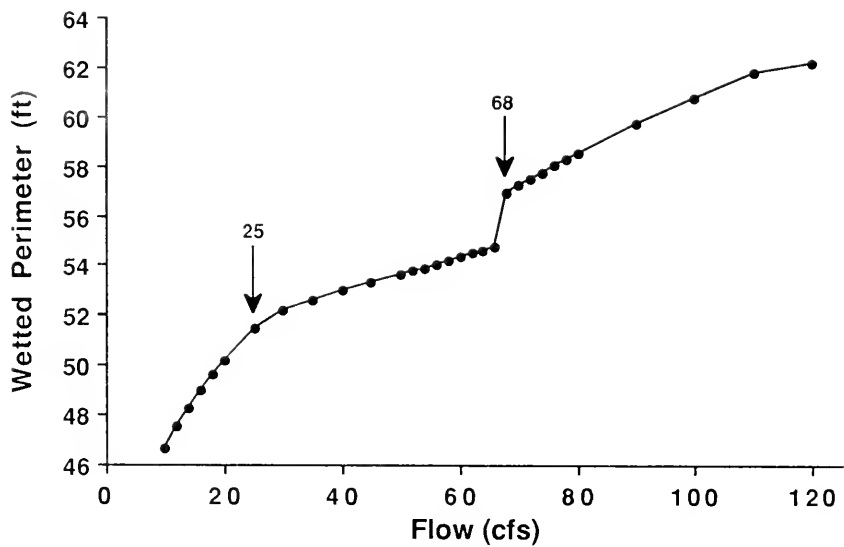


Figure 2-100. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #3 of the Boulder River.

STREAM NAME: South Boulder River

STREAM REACH: From the confluence of Curly Creek to the mouth - 17.0 miles

LOCATION: Sec. 25, T2S, R4W to Sec. 13, T1N, R3W

DESCRIPTION OF STREAM REACH:

The South Boulder River arises in the Tobacco Root Mountains of southwest Montana and flows north almost 20 miles before entering the Jefferson River near Cardwell, Montana. The mean gradient is 149 feet per mile. At spring flow levels the stream averages 38.1 feet in width. The upper 41 percent of the South Boulder is within the Deerlodge National Forest. Major tributaries to the South Boulder River include Limekiln, Carmichael, Rock, McGovern and Curly Creeks as well as its East and West Forks. The South Boulder drains an area of approximately 95 square miles.

Recreational use along the South Boulder River is substantial. It is a popular place to picnic, camp and fish. Access is provided by a gravel road which parallels the stream for much of its length.

Sections of the lower South Boulder are totally dewatered during the summer irrigation season. Other concerns that could potentially affect the stream resource include the subdivision of land surrounding the stream and mining activity within the drainage.

The USGS operated a gage at stream mile 15.2 of the South Boulder River from 1926-34. The mean annual flow for the 7 years of record was 32.8 cfs. Mean monthly flows ranged from 6.9 cfs (for March) to 134.5 cfs (for June). No water was diverted above this site. The SCS (Farnes and Shafer, 1975) estimated the mean annual water yield for the South Boulder drainage at 37,000 acre-feet (51 cfs).

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout.

FISHERY:

A 1,000 ft section of the South Boulder River at about stream mile 9 was electrofished on September 16 and October 24, 1980. One hundred seventy-one rainbow trout, ranging from 2.5-11.3 inches, and 64 brook trout from 3.1-10.4 inches were captured. No other species were present.

The standing crop of rainbow trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-107). This 1,000 ft section supported an estimated 343 rainbow trout, weighing 40 pounds. An estimate could not be obtained for brook trout.

Table 2-107. Estimated standing crop of rainbow trout in a 1,000 ft section of the South Boulder River (T1S, R3W, Sec. 21D) on September 16, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	2.5 - 5.9	204	
	6.0 - 9.9	129	
	10.0 - 11.3	10	
		343(±76)	40(±8)

A 500 ft section of the lower South Boulder River at about stream mile one was electrofished on April 18, 1978. In addition to rainbow and brook trout, brown trout were also present in the lower stream. The electrofishing survey data are summarized in Table 2-108.

Table 2-108. Summary of electrofishing survey data collected for a 500 ft section of the South Boulder River (T1N, R3W, Sec. 24) on April 18, 1978.

Species	Number Captured	Length Range (inches)	Ave. Length (inches)
Rainbow trout	29	3.4 - 13.9	7.5
Brook trout	20	4.3 - 9.9	7.1
Brown trout	13	4.1 - 15.0	9.4
Mottled sculpin	28	-	-

The South Boulder River supports a fairly substantial population of trout for a mountain stream of its size.

WILDLIFE:

Elk, white-tailed and mule deer, moose and mountain goat are year-round residents of the South Boulder River drainage. Black bear, mountain lion, bobcat and an occasional lynx are also present. Mink and beaver are the primary resident furbearers and blue grouse the main game bird.

WETTED PERIMETER:

Cross-sectional measurements for the South Boulder River were made in a 237 ft riffle-pool sequence located near the forest boundary (T1S, R3W, Sec. 28A) at about stream mile 9.4. Five cross-sections were established in this sequence. The WETP program was calibrated to field data collected at flows of 41.3, 75.0 and 162.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-101. Lower and upper inflection points occur at approximate flows of 8 and 12 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 12 cfs (8,688 A.F./yr)

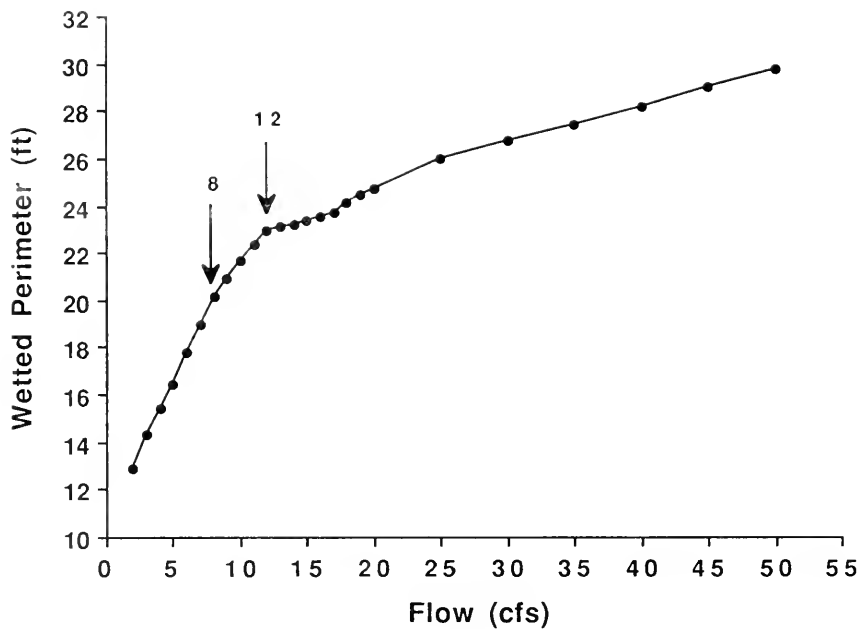


Figure 2-101. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the South Boulder River.

STREAM NAME: South Willow Creek

STREAM REACH: From Granite Lake to the mouth - 21 miles

LOCATION: Sec. 24, T3S, R4W to Sec. 29, T1S, R1W

DESCRIPTION OF STREAM REACH:

South Willow Creek originates at Granite Lake (elevation 8,920 ft) on the southeast side of the Tobacco Root Mountains in southwest Montana and flows about 21 miles before joining North Willow Creek to form Willow Creek, which then flows for about $\frac{1}{2}$ mile before discharging into Willow Creek (Harrison) Reservoir. The mean gradient is 232 feet per mile. At spring flow levels, South Willow Creek averages 26.4 feet in width. Although the upper 60 percent of the stream is within the Beaverhead National Forest, substantial private holdings exist within the Forest, primarily along the creek. Major tributaries are Potosi and Rock Creeks.

Recreational activities along South Willow Creek are mainly confined to camping and fishing. The Beaverhead National Forest maintains a popular campground adjacent to the creek. Access is provided by a gravel road which parallels much of the creek length within the Forest.

The lower portion of South Willow Creek is partially dewatered during the summer irrigation season. Other problems potentially affecting the stream resource include mining, sedimentation resulting from road construction, and over-grazing of the riparian zone by cattle.

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout.

FISHERY:

A 1,000 ft section of South Willow Creek at the Forest boundary was electrofished on September 17 and October 23, 1980. Game fish captured in descending order of abundance were rainbow, brook and brown trout. No non-game species were collected. The electrofishing survey data are summarized in Table 2-109.

Table 2-109. Summary of electrofishing survey data collected for a 1,000 ft section of South Willow Creek (T3S, R2W, Sec. 6A) on September 17 and October 23, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	183	3.3 - 12.9
Brook trout	33	4.2 - 9.9
Brown trout	3	9.3 - 10.5

The standing crop of rainbow trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-110). This 1,000 ft section supported about 325 rainbow trout, weighing 38 pounds. Populations of brook and brown trout were too sparse to estimate using the mark-recapture method.

Table 2-110. Estimated standing crop of rainbow trout in a 1,000 ft section of South Willow Creek (T3S, R2W, Sec. 6A) on September 17, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.3 - 5.9	195	
	6.0 - 9.9	123	
	10.0 - 12.9	7	
		325(±56)	38(±5)

From 1984 to 1986, Schrader (in publication) made a series of four population estimates in each of three study sections of South Willow Creek within the Forest boundary. Fall biomass estimates of three inch and longer trout ranged from 35-68 pounds per 1,000 ft for the three sections, while spring biomass estimates ranged from 25-47 pounds per 1,000 ft. In the high gradient sections the rainbow trout predominated, while in low gradient areas brook trout comprised about 50% of the population. Most rainbow and brook trout were small (less than 10 inches), with few exceeding 12 inches. A few larger brown trout (14-18 inches) were present.

The MDFWP began a program in 1978 to re-establish a self-sustaining population of rainbow trout in Willow Creek Reservoir by planting fingerlings of a wild strain of trout into the Willow Creek drainage. The continued stocking of a domestic strain of hatchery rainbow trout over the years had apparently eliminated the reproducing wild trout population of the reservoir, resulting in a poor recreational fishery. The wild fingerlings were expected to rear in the tributaries, move downstream to the reservoir to grow to adulthood and, when sexually mature, return to their "natal" streams to spawn.

In the spring of 1981, the re-established rainbow spawning run was large enough to again be used as an egg source for the Department's Anaconda Trout Hatchery. A portion of the run is trapped each spring in Willow Creek, eggs are stripped and fertilized, then transferred to the hatchery where the young are raised for release into other waters. Between 1981-87, from 1,000 to 3,500 rainbow trout spawners, averaging 18.6 inches in length, were trapped each year. Spawners commonly ascend South Willow Creek 2-3 miles above its mouth, with some fish migrating as far as the Beaverhead National Forest, a distance of over 13 miles.

In addition, brown trout spawners ascend South Willow Creek in the fall. Based on trap data, about 800-1,000 reservoir brown trout, averaging about 14 inches in length, spawn in the Willow Creek system each year.

The excellent recreational fishery of Willow Creek Reservoir is maintained entirely by the natural reproduction that occurs in Willow Creek, North and South Willow Creeks and other reservoir tributaries.

WILDLIFE:

Mule deer, elk and moose are year-round residents of the South Willow Creek drainage. Other resident wildlife include black bear, beaver and mink. Blue grouse and Hungarian partridge are the main game birds within the drainage.

WETTED PERIMETER:

Cross-sectional measurements for South Willow Creek were made in a 116 ft riffle-pool sequence located immediately above the forest boundary (T3S, R2W, Sec. 6A). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 18.8, 35.7 and 77.7 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-102. A prominent upper inflection point occurs at an approximate flow of 14 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect important spawning and nursery habitats for the rainbow and brown trout populations of Willow Creek Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

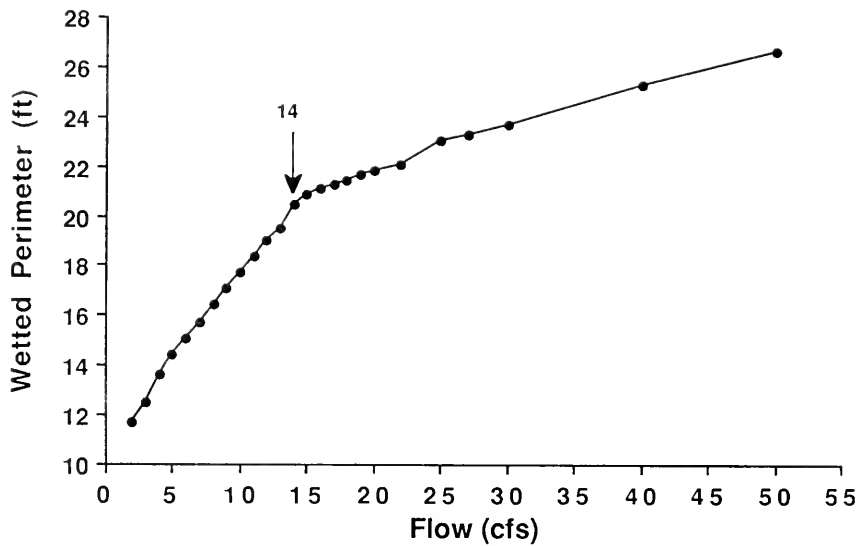


Figure 2-102. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in South Willow Creek.

STREAM NAME: North Willow Creek

STREAM REACH: From Hollow Top Lake to the mouth - 15.5 miles

LOCATION: Sec. 4, T3S, R3W to Sec. 29, T1S, R1W

DESCRIPTION OF STREAM REACH:

North Willow Creek arises on the east slope of the Tobacco Root Mountains at Hollow Top Lake (elevation 8,560 feet) and flows 15.5 miles before joining South Willow Creek to form Willow Creek, which then flows for about $\frac{1}{2}$ mile before discharging into Willow Creek (Harrison) Reservoir. The stream gradient averages 318 feet per mile. At spring flow levels, North Willow Creek averages 12.0 feet in width.

The upper half of the drainage is within the Beaverhead National Forest while the lower portion is surrounded by privately owned agricultural land. Major tributaries are Cataract, Pony and Charcoal Creeks. Presently, the flow in North Willow Creek is unregulated. In the past, lakes within the drainage have been artificially raised and installed with headgates to control the flow.

The lower half of North Willow Creek is partially dewatered during the summer irrigation season. Other concerns that could affect the stream resource include the extensive mining operations within the area, road building and the resulting sedimentation, and overgrazing of the riparian zone by cattle.

GAME FISH PRESENT: Brook trout, rainbow trout, brown trout.

FISHERY:

A 1,000 ft section of North Willow Creek near the forest boundary was electrofished on September 16 and October 23, 1980. Game fish captured in descending order of abundance were brook, brown and rainbow trout. The mottled sculpin was the only non-game species captured. The electrofishing survey data are summarized in Table 2-111.

Table 2-111. Summary of electrofishing survey data collected for a 1,000 ft section of North Willow Creek (T2S, R3W, Sec. 24A) on September 16 and October 23, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	161	3.0 - 10.5
Brown trout	2	8.1 - 10.7
Rainbow trout	1	9.8
Mottled sculpin	-	-

The standing crop of brook trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-112). This 1,000 ft section supported an estimated population of 268 brook trout 4.0 inches and longer, weighing 42 pounds. Populations of brown and rainbow trout were too sparse to estimate using the mark-recapture method.

Table 2-112. Estimated standing crop of brook trout in a 1,000 ft section of North Willow Creek (T2S, R3W, Sec. 24A) on September 16, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	83	
	6.0 - 9.9	177	
	10.0 - 10.5	8	
		268(±53)	42(±11)

The MDFWP began a program in 1978 to re-establish a self-sustaining population of rainbow trout in Willow Creek Reservoir by planting fingerlings of a wild strain of trout into the Willow Creek drainage. The continued stocking of a domesticated strain of hatchery rainbow trout over the years had apparently eliminated the reproducing wild trout population, resulting in a poor recreational fishery in the reservoir. The plant of wild fingerlings was expected to rear in the tributaries, move downstream to the reservoir to grow to adulthood and, when sexually mature, return to their "natal" stream to spawn.

In the spring of 1981, the re-established rainbow spawning run was large enough to again be used as an egg source for the Department's Anaconda Trout Hatchery. A portion of the run is trapped each spring, eggs are stripped and fertilized, then transferred to the hatchery where the young are raised for release into other waters. Between 1981-87, from 1,000 to 3,500 rainbow trout spawners, averaging 18.6 inches in length, were captured each year. The distance rainbow trout ascend North Willow Creek is unknown. Limited electrofishing work has shown that spawners are common at the Highway #287 bridge at Harrison, 2½ miles above the mouth.

In addition, brown trout spawners ascend North Willow Creek in the fall. Based on trap data, about 800-1,000 brown trout, averaging about 14 inches in length, enter the Willow Creek system each year.

The excellent recreational fishery of Willow Creek Reservoir is maintained entirely by the natural reproduction that occurs in Willow Creek, North and South Willow Creeks and other reservoir tributaries.

WILDLIFE:

Mule deer, elk and moose are year-round residents of the North Willow Creek drainage. Other wildlife species present include black bear, beaver and mink. The primary game birds within the drainage are blue grouse and Hungarian partridge.

WETTED PERIMETER:

Cross-sectional measurements for North Willow Creek were made in a 76 ft cascading section located immediately above the forest boundary (T2S, R3W, Sec. 25B). Five cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 8.2, 8.7 and 18.2 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-103. Lower and upper inflection points occur at approximate flows of 3 and 7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect important spawning and nursery habitats for the rainbow and brown trout populations of Willow Creek Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 7 cfs (5,068 A.F./yr)

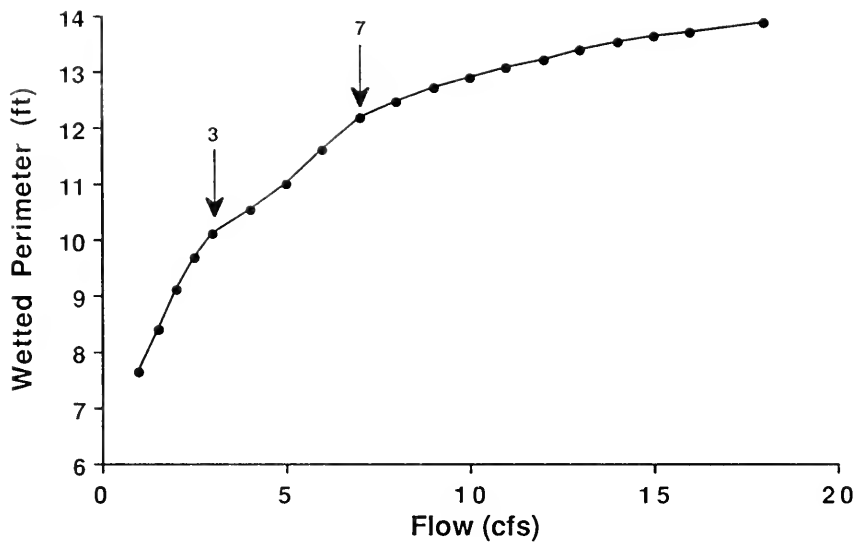


Figure 2-103. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in North Willow Creek.

STREAM NAME: Willow Creek

STREAM REACH: From the convergence of North and South Willow Creeks to the mouth - 12.0 miles

LOCATION: Sec. 29, T1S, R1W to Sec. 24, T1N, R1W

DESCRIPTION OF STREAM REACH:

Willow Creek originates at the convergence of North and South Willow Creeks then flows 0.5 miles to Willow Creek Reservoir, a state-owned, 885-acre irrigation storage facility completed in 1938. Below Willow Creek Dam, the stream continues for an additional 11.5 miles, passing through a narrow, steep canyon and open agricultural lands before discharging into the Jefferson River. The open, dry hillsides surrounding the canyon are vegetated with grasses, sagebrush and scattered mountain mahogany and juniper. Below the canyon, adjacent lands are used for irrigated hay and grain production. Except for a $\frac{1}{4}$ mile section of stream within a BLM parcel, Willow Creek is surrounded by privately owned lands.

The USGS has operated a gage on Willow Creek directly below the confluence of North and South Willow Creeks since 1938. The mean annual flow for a 41-year period of record was 39.8 cfs. Mean monthly flows ranged from 12 cfs (for August) to 110 cfs (for June). Base winter flow was 25 cfs. Water to irrigate about 12,500 acres is diverted above this site.

A USGS gage at stream mile 7.0 (below Willow Creek Reservoir) was operated between 1919 and 1956. The mean annual flow for a 20-year period of record was 51.0 cfs. Before regulation occurred in 1938, the lowest mean monthly flow of record was 27.1 cfs (for January). After Willow Creek Dam was constructed and began storing water during the winter low flow period, the lowest mean monthly flow was reduced to 16.8 cfs (for March).

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, brook trout.

FISHERY:

Two 500 ft sections of lower Willow Creek were electrofished on April 18 and 28, 1978. The sections were located within agricultural lands about $\frac{3}{4}$ and 2 miles upstream from the mouth. Brown trout, mountain whitefish and rainbow trout were the game species captured. Non-game fish present were white, longnose and mountain suckers, longnose dace and mottled sculpin. Combined results of the survey are summarized in Table 2-113.

Table 2-113. Summary of fish species captured by electrofishing in two 500 ft sections of Willow Creek (Sec. 31, T1N, R1E and Sec. 25, T1N, R1W) in April, 1978.

Species	Number Captured	Length Range (inches)	Ave. Length (inches)
Brown trout	34	4.3 - 17.6	11.0
Mountain whitefish	31	4.6 - 14.4	10.1
Rainbow trout	7	8.3 - 14.9	11.0
White sucker	32	2.8 - 12.6	6.4
Longnose sucker	10	3.4 - 15.5	5.5
Mountain sucker	1	3.4	-
Longnose dace	Uncommon		
Mottled sculpin	Common		

Willow Creek, particularly the canyon reach, is a popular and highly productive sport fishery. The canyon section is noted for producing large brown trout, some exceeding 5 pounds, and an abundance of rainbow trout in the 11-13 inch class. In April, 1981, a 1,000 ft stream section at the mouth of the canyon supported an estimated 292 rainbow trout and 23 brown trout longer than 10 inches.

In addition to supporting resident populations of rainbow, brown and brook trout, the $\frac{1}{2}$ mile section of Willow Creek upstream from the reservoir provides important spawning and nursery habitats for the rainbow and brown trout populations of Willow Creek Reservoir. The excellent recreational fishery of the reservoir is maintained entirely by the natural reproduction that occurs in Willow Creek, North and South Willow Creeks and other reservoir tributaries.

A portion of the rainbow trout spawning run that ascends Willow Creek each spring is trapped by the MDFWP, eggs are stripped and fertilized, then transferred to a state hatchery where the young are raised for release into other waters. Between 1981-87, from 1,000 to 3,500 rainbow trout spawners, averaging 18.6 inches in length, were trapped each year. In addition, brown trout spawners ascend Willow Creek each fall. Based on trap data, about 800-1,000 reservoir brown trout, averaging about 14 inches in length, annually spawn in the Willow Creek system.

WILDLIFE:

Lands along Willow Creek support year-round populations of mule deer and a few white-tailed deer. Antelope are present year-round on the benches above the creek. Other wildlife inhabitants include mink, beaver, otter, red fox, coyote, badger and bobcat. Hungarian partridge and a few ring-necked pheasant are the resident upland game birds.

WETTED PERIMETER:

Cross-sectional measurements for Willow Creek were made in a section of stream in Sec. 7D, T1S, R1E. The WETP program was calibrated to field data collected at flows of 39.9, 105.6 and 162.1 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections (Figure 2-104) shows lower and upper inflection points at about 7 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter; and, in the $\frac{1}{4}$ mile of Willow Creek above Willow Creek Reservoir, to protect important spawning and nursery habitats for trout residing in the reservoir.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

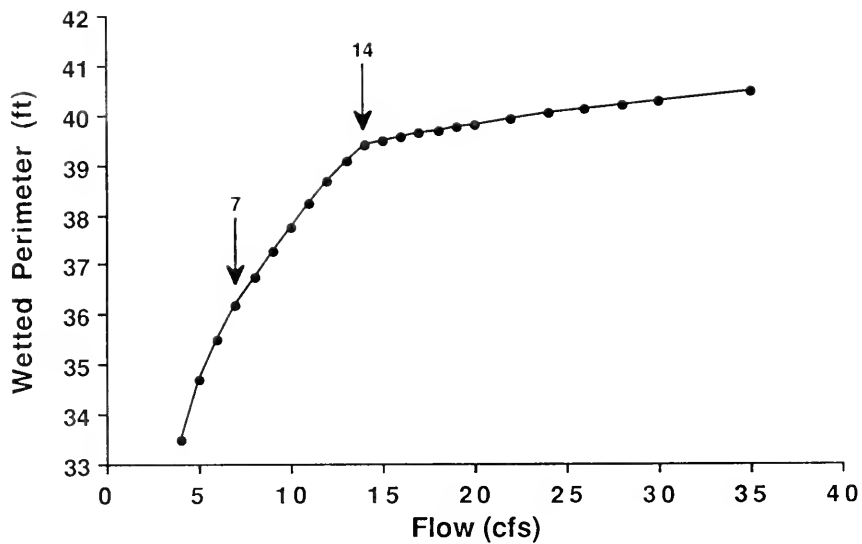


Figure 2-104. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Willow Creek.

MADISON RIVER SUB-BASIN

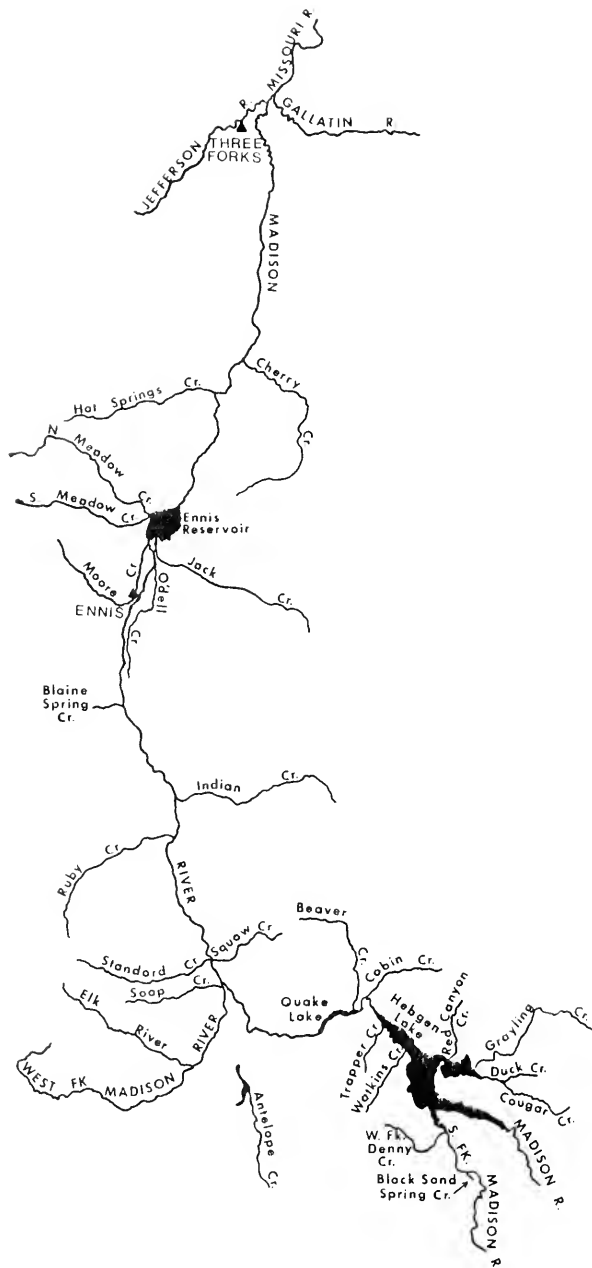


Figure 2-105. Map of the Madison River Sub-Basin.

STREAM NAME: Madison River

DESCRIPTION OF BASIN:

The Madison River originates in Yellowstone National Park at the junction of the Firehole and Gibbon rivers. It then flows in a northerly direction for 149 miles to Three Forks, Montana, where it joins the Jefferson and Gallatin rivers to form the Missouri River. There are two impoundments on the river; Hebgen Reservoir, located 1.5 miles downstream from the park boundary, and Ennis Reservoir, located 65 miles downstream from Hebgen Reservoir. From its source in the park, the Madison crosses a high forested plateau (7,000 ft and higher in elevation) to Hebgen Reservoir. Upon leaving Hebgen Reservoir, the Madison flows about 3 miles through a narrow canyon to Earthquake Lake, a natural lake formed by an earth slide during a major earthquake on August 17, 1959. Below Earthquake Lake the river enters the upper Madison River valley where it flows about 57 miles before entering Ennis Reservoir. After leaving Ennis Reservoir, the Madison enters a narrow gorge (Bear Trap Canyon) where it flows about 14 miles before entering the lower Madison River valley for the final 26 miles to its junction with the Jefferson and Gallatin rivers.

The Madison River drains approximately 2,500 square miles. About 70 percent of the drainage is covered with coniferous forests. The riparian zone of the wide, open upper and lower Madison River valleys is vegetated with willow, alder, cottonwood, and an occasional conifer. Vegetation in the riparian zone of the lower Madison valley is denser than that in the upper valley. Agricultural lands in the upper and lower valley are primarily used for cattle grazing and hay production. The subdivision of agricultural lands along the river in the upper valley is increasing.

There are about 102 tributaries to Montana's portion of the Madison River. Most are short, small and have limited fishery value. About 20 tributaries provide a significant trout fishery and/or waterfowl habitat.

The Madison River is one of Montana's premier wild trout fisheries. High scenic values, good public access and excellent wild trout populations have all contributed to its national reputation as an outstanding sport fishery and have led to its designation as a "Blue Ribbon" trout stream by the MDFWP.

Fishing pressure has increased more than five fold since the early 1950's. For the 102 miles of free-flowing river in Montana, angling pressure increased from an estimated 22,660 man-days in 1952 (USFWS, 1952) to 125,726 man-days between May, 1983 and April 1984 (MDFWP, 1984). Nonresidents accounted for 27 percent of the total pressure in 1952 and 62 percent in 1983-84.

Float fishing and recreational floating are popular on the Madison River. Boat pressure is high when compared to other rivers within the state.

Flows in the Madison River are regulated by the two reservoirs. Hebgen Reservoir, built in 1915 by the Montana Power company, stores water for downstream power generation. Water storage usually occurs during the snow runoff period of mid-May through early June. Stored water is released to

downstream reservoirs during the fall (October-December). Fall releases usually range from 1,500 to 2,200 cfs at Hebgen Dam. Ennis Reservoir, built in 1980 by the Montana Power Company, has a rather stable water level with little storage capacity of its own. Its primary function is to create a head for the power generating facility immediately below Ennis Dam. Outflows from Ennis Reservoir are mainly regulated at Hebgen Dam.

Sub-surface water sources in Yellowstone National Park have a stabilizing influence on the seasonal flow pattern of the Madison River. As a result, the river exhibits a larger base flow in proportion to its annual runoff than most rivers in Montana. Thus, the Madison River's seasonal flow pattern more closely resembles that of a giant spring-fed creek rather than a typical snow-fed mountain trout stream.

STREAM NAME: Madison River

STREAM REACH: #1. From the Yellowstone National Park boundary to Hebgen Reservoir - 0.8 miles

LOCATION: NW, Sec. 10, T13S, R5E to SE, Sec. 10, T13S, R5E

DESCRIPTION OF STREAM REACH:

Reach #1 is the 0.8 mile of the Madison River extending from the Yellowstone Park boundary to Hebgen Reservoir - a hydropower storage facility built in 1915 by the Montana Power Company. This short stretch of river flows through a wide, fairly open, high elevation (about 7,000 ft) flat that is vegetated with grasses, widely spaced conifers and scattered willows. Average channel width at low flow is 135 ft. The bottom substrate consists of fine, unstable sands and gravels that are covered in places by mats of aquatic vegetation. Lands surrounding Reach #1 are managed by the U.S. Forest Service primarily for recreation.

Sub-surface water sources in Yellowstone Park have produced fairly stable, year-round flows in the upper Madison River. Mean monthly flows, as measured at the USGS gage located 6.5 miles upstream from the Park boundary, ranged from 393 cfs (in February) to 808 cfs (in May) for the 58-year period of record. The mean annual flow was 488 cfs. No irrigation diversions occur in or above Reach #1.

GAME FISH PRESENT: Mountain whitefish, brown trout, rainbow trout, cutthroat trout.

FISHERY:

Reach #1 is noted for its excellent fall sport fishery for Hebgen Reservoir brown trout that ascend the Madison River and its tributaries to spawn. A substantial fall spawning run of mountain whitefish also occurs. In addition, the Madison River drainage provides spawning and nursery habitats for reservoir rainbow trout, which ascend the river in large numbers in spring. This spring run, however, is untapped by anglers because it occurs when the fishing season is closed. (In fall, fishermen on the Madison River catch large numbers of reservoir rainbow trout in the 16-20 inch class. Speculation is that these fish follow the brown trout spawners to feed on their eggs.) The Madison drainage undoubtedly contributes substantial numbers of young recruits - both brown and rainbow trout - to the Hebgen Reservoir fishery.

Up until 1954 when the MDFWP began to phase out its spawn-taking stations, a fish trap was operated on the Madison River for purposes of capturing spawning rainbow and brown trout from Hebgen Reservoir. Eggs and milt from these fish were artificially stripped and the fertilized eggs taken to a state hatchery where the young were raised for release into other state waters. Up to 20 million eggs were taken each year.

In 1979, the MDFWP began a program to establish a reproducing cutthroat population in Hebgen Reservoir to diversify angling opportunities. Reservoir tributaries, including the Madison River, received imprint plants of young

McBride cutthroat trout - a wild strain originating at McBride Lake in Yellowstone National Park. These young fish were expected to rear in the streams, move to the reservoir to grow to adulthood and, when sexually mature at 3-5 years of age, return to their "natal" streams to spawn. While spawning runs by Hebgen's expanding cutthroat population have not been documented in the Madison River to date, the potential for such runs does exist.

Reach #1 itself is not considered a prime spawning area due to the scarcity of preferred gravels. While some spawning does occur, Reach #1 primarily provides rearing habitat for young trout and a corridor for migrating adults.

Reach #1 also supports a year-round, resident trout population. Electrofishing surveys indicate that resident brown and rainbow trout are relatively few in number and small in size.

WILDLIFE:

Big game species utilizing the flat surrounding Reach #1 include bison, elk, mule deer, moose, black bear and an occasional grizzly bear. Furbearers associated with the river include otter, mink, muskrat and beaver. Waterfowl are commonly observed during spring and fall migrations. Canada geese and mergansers utilize the river area for nesting and the rearing of their young. Ospreys and bald eagles are summer inhabitants commonly seen along the river corridor.

WETTED PERIMETER:

Cross-sectional measurements for use in the wetted perimeter inflection point method were made in an approximate $\frac{1}{4}$ mile section of Reach #1. Four cross-sections were established in two riffle-like area. The WETP program was calibrated to field data collected at flows of 627, 694 and 909 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-106. Lower and upper inflection points occur at approximate flows of 240 and 500 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain rearing and some spawning habitats for brown, rainbow and cutthroat trout and mountain whitefish from Hebgen Reservoir that ascend the Madison River to reproduce; to maintain existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 500 cfs (361,983 A.F./yr)

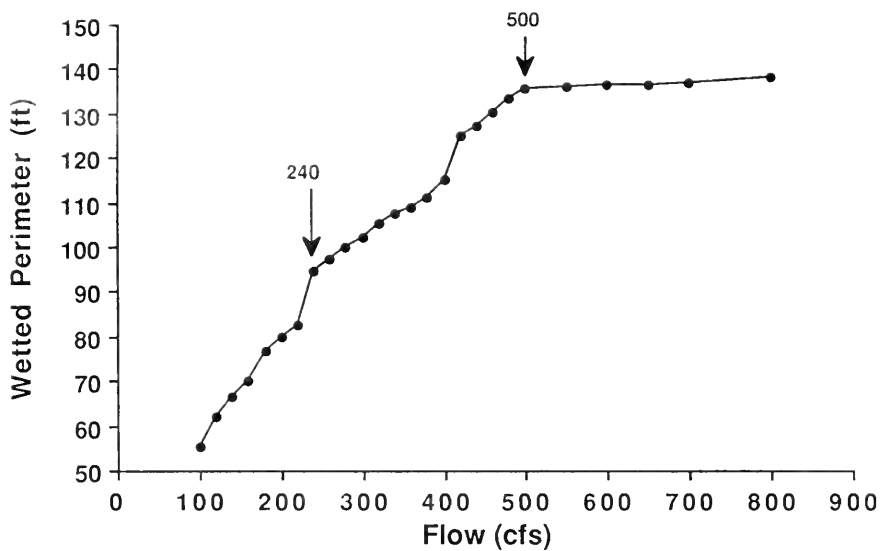


Figure 2-106. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Reach #1 of the Madison River.

STREAM NAME: Madison River

STREAM REACH: #2. From Hebgen Dam to the confluence of the West Fork-
15.1 miles

LOCATION: Sec. 23, T11S, R3E to Sec. 10, T11S, R1E

DESCRIPTION OF STREAM REACH:

The upper 3.3 miles of Reach #2 flow through a narrow canyon between Hebgen Dam and Earthquake Lake - a natural lake formed by a massive earth slide in 1959. This short stretch of river can be severely dewatered during spring runoff when Hebgen Reservoir is filled and flow releases into the river are reduced.

The lower 11.8 miles of Reach #2 flow between the outlet of Earthquake Lake and the confluence of the West Fork. Here, the river leaves the canyon and enters the upper Madison Valley. The river is wide (average width of 220 ft at low flow) and shallow, with depths rarely exceeding 4 ft. Riffle-run areas interspersed with large boulders predominate. The reach has a boulder-cobble-gravel substrate and gradient averages 27 ft per mile. The floodplain is vegetated with grasses mixed with willows, alders and occasional cottonwoods and conifers.

Long-term gage records are available for a site at the head of Reach #2 immediately below Hebgen Dam. The mean annual flow for a 40-year period of record (1939-79) was 1,030 cfs. Mean monthly flows ranged from 681 cfs (for May) to 1,400 cfs (for October). Flows at the downstream boundary of Reach #2 are somewhat higher than those measured at this gage due to tributary inflows. Cabin and Beaver Creeks - two major tributaries that enter near the head of the reach - annually contribute about 98 cfs, on average, to Reach #2.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, cutthroat trout.

FISHERY:

Rainbow trout, brown trout, mountain whitefish and an occasional cutthroat trout comprise the sport fish in the canyon section of Reach #2 upstream from Earthquake Lake. Trout occasionally reach weights to 4 pounds, but most are in the 10-15 inch class. Scale analyses indicated that many of the trout creel by anglers are part-time residents of Earthquake Lake. Angling pressure on this stretch in 1977 was estimated at 1,561 man-days per river mile and the catch rate was 0.67 trout per hour.

Below Earthquake Lake, the rainbow trout predominates, followed by brown trout, mountain whitefish and an occasional cutthroat trout. Non-game species include longnose sucker, white sucker, mountain sucker and mottled sculpin.

Beginning in 1975, the MDFWP annually estimated trout populations in sections of Reach #2 below Earthquake Lake using an electrofishing technique. The estimates were made in conjunction with a study evaluating the effects of

special angling regulations and heavy fishing pressure on wild trout populations. A recent estimate (September, 1983) showed that a mile of river supported about 3,011 rainbow and brown trout 9 inches and longer, weighing 2,401 pounds. Anglers annually report catching trout in excess of five pounds, although few trout exceed three pounds.

The section of Reach #1 below Earthquake Lake is presently restricted to catch-and-release fishing with artificial lures and flies only. These restrictive angling regulations, which were advocated and overwhelmingly supported by the angling public, were initiated in 1978 for the purpose of providing anglers with the opportunity to catch larger size trout.

A creel survey conducted by the MDFWP in the summer of 1979 showed that angling pressure for this section amounted to about 983 man-days/river mile/year (Vincent and Clancy, 1980). About 90 percent of the angling pressure was generated by nonresidents.

WILDLIFE:

Big game animals using the river bottom in the canyon portion of Reach #2 are moose, elk, mule deer and black bear. Resident upland game birds are blue grouse and ruffed grouse. Bald and golden eagles are commonly observed within the river corridor. Adjacent mountainsides are included in designated habitat for grizzly bears.

Below Earthquake Lake, moose, elk and mule deer are found within the floodplain. Within a one mile radius of the earthquake slide area, winter range for about 150 mule deer, 200 elk, 40 mountain goats and up to 40 bighorn sheep is provided. Canada geese are common nesters along this stretch of river. Some waterfowl use occurs during the spring and fall migrations. Furbearers associated with the river and adjacent lands are mink, beaver, otter, bobcat and coyote.

WETTED PERIMETER:

The wetted perimeter inflection point method was applied to a 296-ft-long study section located near the downstream boundary of Reach #2. The WETP program was calibrated to field data collected at flows of 918, 1,211 and 1,555 cfs. The wetted perimeter-flow relationship for a single riffle cross-section (Figure 2-107) shows a prominent upper inflection point at approximately 800 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 800 cfs (579,173 A.F./yr)

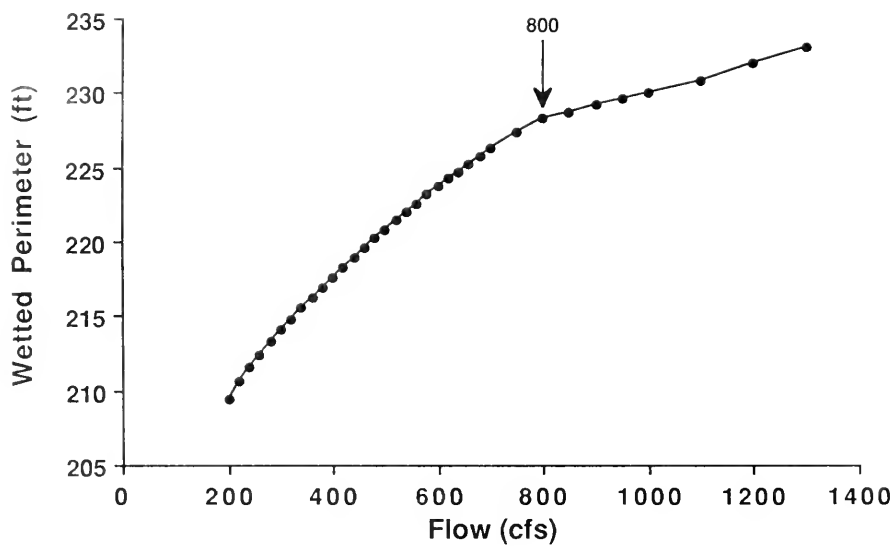


Figure 2-107. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #2 of the Madison River.

STREAM NAME: Madison River

STREAM REACH: #3. From the confluence of the West Fork to Ennis Reservoir-
44.3 miles

LOCATION: Sec. 10, T11S, R1E to Sec. 10 and 11, T5S, R1W

DESCRIPTION OF STREAM REACH:

Reach #3 lies within the upper Madison River Valley. The upper 29 miles of the reach are wide (200-300 ft, averaging 245 ft) and shallow, with depths less than 3 ft throughout much of this section. The river consists primarily of riffle-run areas interspersed with large boulders. Few pools are found. The banks are primarily vegetated with willow and alder, with an occasional cottonwood.

In the lower 15 miles, the river channel braids, forming many islands and side channels. This section also consists primarily of riffle-run areas, with few pools. Much of the river is 2-5 ft in depth, with a maximum depth of about 6 ft. Bank vegetation is denser than that along the upper 14 miles, with cottonwoods being more abundant.

The gradient in Reach #3 averages about 17 ft per mile. The reach has a boulder-cobble-gravel substrate. In 1972-77, summer water temperatures (July-August) averaged 59.8 F, considered ideal for optimum trout growth.

The USGS operated a gage towards the lower end of Reach #3 (at river mile 14 of Reach #3) between 1951 and 1970. The mean annual flow for the 13-year period of record was 1,432 cfs. Mean monthly flows ranged from 923 cfs (for March) to 2,360 cfs (for June). About 5,300 acres of land above this gage site are irrigated.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, cutthroat trout, arctic grayling.

FISHERY:

Rainbow, brown and cutthroat trout, mountain whitefish and an occasional arctic grayling comprise the game fish in Reach #3 of the Madison River. Non-game species include longnose sucker, white sucker, mountain sucker and mottled sculpin. Anglers annually report catching trout in excess of five pounds in this reach. However, the vast majority of the catch is within the 12-16 inch group.

Beginning in 1967, the MDFWP has annually estimated the numbers and pounds of trout in a 4.2 mile section of Reach #3 using an electrofishing technique. The estimates were made in conjunction with studies evaluating the effects of special angling regulations, heavy fishing pressure and the stocking of hatchery trout on wild trout populations. A recent estimate (September, 1983) showed that a mile of river supported about 1,857 catchable-size (about 9 inches and longer) rainbow and brown trout, weighing a total of 1,760 pounds. The brown trout is the predominant trout species, comprising about 77 percent of the trout numbers.

A 30 mile portion of Reach #3 is presently restricted to catch-and-release fishing with artificial lures and flies only. These restrictive angling regulations, which were advocated and overwhelmingly supported by the angling public, were initiated in 1978 for the purpose of providing anglers with the opportunity to catch larger-size trout. For the remaining 14 miles of Reach #3, bait fishing is allowed and the limit is three trout per day.

The fishing pressure on Reach #3 of the Madison River from May, 1983 through April, 1984 was estimated at 759 man-days per river mile (MDFWP, 1984), making this reach of river one of the most heavily used recreational river fisheries in southwest Montana. About 82 percent of the pressure was generated by nonresidents.

WILDLIFE:

Big game animals using the floodplain along Reach #3 are moose, elk and mule deer. Upland game birds include ruffed grouse, Hungarian partridge and an occasional ring-necked pheasant. Bald and golden eagles and ospreys are frequently observed in the river corridor. Common furbearers associated with the river and its riparian zone are beaver, muskrat, mink, bobcat, red fox, otter and coyote.

Waterfowl use the river extensively during spring and fall migrations. Nesting waterfowl include Canada geese, mallard, blue-winged teal and common merganser. Of the nesting waterfowl, the Canada goose is the most important. The heaviest goose nesting concentration on the entire Madison River occurs in Reach #3 between Ennis Reservoir and the town of Ennis.

WETTED PERIMETER:

The wetted perimeter inflection point method was applied to a riffle area near the lower end of Reach #3 at the Ennis fishing Access Site (Sec. 4, T6S, R1W). The WETP program was calibrated to field data collected at flows of 1,100 to 2,058 cfs. Lower and upper inflection points on the wetted perimeter-flow relationship for the composite of three riffle cross-sections (Figure 2-108) occur at approximate flows of 350 and 1,000 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1,000 cfs (723,967 A.F./yr)

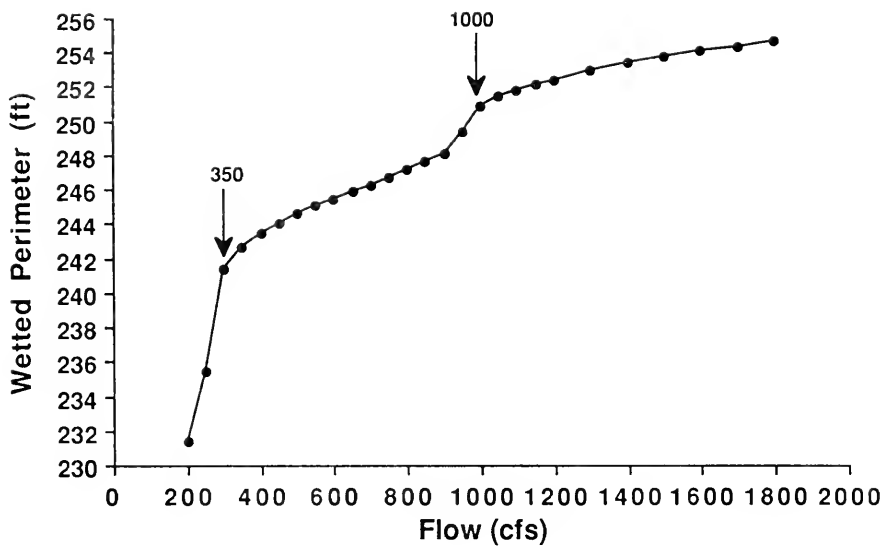


Figure 2-108. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Reach #3 of the Madison River.

STREAM NAME: Madison River

STREAM REACH: #4. From Ennis Dam to the mouth - 40.3 miles

LOCATION: Sec. 20, T4S, R1E to Sec. 17, T2N, R2E

DESCRIPTION OF STREAM REACH:

Below Ennis Dam, the Madison River flows for about 14 miles through the Bear Trap Canyon, virtually all of which is within the Bear Trap Wilderness Area. Here, the channel is constricted between the narrow canyon walls and flow is turbulent as the river passes over a bed of large boulders, some car-size, and cobbles. Below the Bear Trap Canyon, the river enters the lower Madison River Valley where it flows 26 miles through mostly private agricultural lands before joining the Jefferson River. The lower river is fairly wide and shallow and has a cobble-gravel-silt bottom that is covered in places by mats of aquatic vegetation during the summer. Islands are common, particularly towards the river's mouth. The immediate floodplain is vegetated with willow, alder and numerous cottonwoods.

Water is diverted from Reach #4 to irrigate crop lands in the lower valley. Dewatering, however, is not considered severe.

Long-term flow records are available for two USGS gage sites in Reach #4. The mean annual flow at the gage at river mile 9.6 for a 16-year period of record ending in 1950 was 1,650 cfs. Mean monthly flows of record ranged from 1,340 cfs (for November) to 3,030 cfs (for June). The gage at river mile 38.8 showed a mean annual flow of 1,758 cfs for a 41-year period of record. Mean monthly flows ranged from 1,390 cfs (for the months of January and February) to 2,900 cfs (for June).

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout, cutthroat trout, arctic grayling.

FISHERY:

Brown trout, rainbow trout, mountain whitefish and occasional arctic grayling, brook trout and cutthroat trout comprise the game fish in Reach #4 of the Madison River. Non-game fish present include white sucker, longnose sucker, mountain sucker, mottled sculpin, longnose dace, Utah chub, carp and yellow perch.

Since 1967, the MDFWP has annually estimated trout populations using an electrofishing technique in a 4-mile section of this reach. The estimate made in April, 1982 showed that a mile of river supported approximately 5,806 adult trout (about 9 inches and longer), weighing 2,904 pounds. Trout as large as 6.75 pounds have been captured during the department's electrofishing efforts. Anglers annually catch brown and rainbow trout as large as 4 to 5 pounds, but few exceed 2 pounds.

A 1983-84 estimate of angling pressure for this reach was 41,070 man-days per year (MDFWP, 1984). Nonresidents accounted for 28 percent of the pressure.

WILDLIFE:

Big game animals found in the immediate vicinity of the river in the Bear Trap Canyon are mountain goat, black bear, mule deer and bighorn sheep. Both mule deer and white-tailed deer are commonly seen along the river in the lower Madison valley. Resident upland game birds include blue grouse, ruffed grouse, Hungarian partridge, sharp-tailed grouse and ring-necked pheasant. Bald eagles and ospreys are commonly observed in the river corridor. Golden eagles nest in the Bear Trap Canyon and prairie falcons nest along the cliffs bordering the river in the lower Madison valley. Furbearers associated with the river and its riparian zone are beaver, mink, muskrat, otter, raccoon and coyote.

Waterfowl use the river extensively during spring and fall migrations. Canada geese are common nesters on the islands in the lower valley. Other nesting waterfowl include common merganser, mallard and blue-winged teal. Goldeneyes and mergansers commonly winter on the river. The hunting of ducks and geese is popular during the waterfowl season.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1,300 cfs (941,157 A.F./yr)

Flows in the Madison River are primarily regulated at Hebgen Reservoir where water for downstream hydroelectric generation is stored. Before 1968, the Montana Power Company, operator of Hebgen Dam, began storing water in late February to early March prior to the onset of spring runoff. This policy resulted in extremely low flows throughout the Madison River during late winter and early spring. In 1968, Montana Power agreed to start storing water when runoff begins in late April to early May. This change resulted in higher flows in the river from February to May and a subsequent increase in the Madison River trout population.

The estimated numbers and pounds of adult trout in a 4-mile section of Reach #4 in the spring of 1967, prior to the winter flow increases, and in the spring of 1968, 1969, 1970 and 1971, after flows were increased, are shown in Table 2-114. In 1971, 3 years after the management change, the total number and pounds of adult trout were 171 and 124 percent, respectively, of those in 1967.

It is assumed that the reduced winter flows prior to 1968 were the major factor limiting the trout populations, and the population increases between 1967 and 1971 primarily reflected the higher flows following the change in storage policy. In recent years, fishing pressure and elevated summer water temperatures resulting from the thermal heating of Ennis Reservoir are known to affect trout populations in this reach. While these limiting factors were probably operating prior to 1971, flow was assumed to be the overriding controlling factor.

Table 2-114. Distribution of the average daily flows during the approximate 12-month period preceding the trout population estimates in a 4-mile section of the lower Madison River in Spring 1967 through Spring 1971.

Spring to Spring	Average Daily Flows (cfs)															Adult Trout	
	695	700	700	800	899	999	1000	1100	1200	1300	1400	1500	1600	1700	≥1800	Number	Biomass (lbs)
1966-67	1	16	10	8	36	37	37	37	63	42	26	17	9	90		6,779	5,452
1967-68	0	0	0	3	3	6	7	17	27	23	26	28	182	182		9,818	5,752
1968-69	0	0	0	2	9	10	19	18	26	55	37	31	171	171		9,625	6,832
1969-70	0	0	0	0	0	0	1	9	29	39	50	23	207	207		12,248	6,803
1970-71	0	0	0	1	2	6	8	16	15	93	13	15	192	192		11,613	6,758

The distribution of the average daily flows for the approximate 12-month period preceding each estimate shows the magnitude of the flow increases following the 1967 estimate (Table 2-114). The lowest estimate of trout numbers and pounds (in 1967) followed the 12-month period containing the lowest flows. Between the Spring of 1966 and 1967, 7 percent of the average daily flows were less than 900 cfs versus 0 percent for the other years, and 18 percent were less than 1,100 cfs versus 0-3 percent for other years. The highest estimate of trout numbers (in 1970) followed the 12-month period containing the highest flows. Between the Spring of 1969 and 1970, 97 percent of the average daily flows exceeded 1,400 cfs and none were less than 1,240 cfs. The estimated pounds of trout peaked in 1969 and remained stable through 1970 and 1971. During the 12-month period preceding each of these three biomass estimates, 94 to 100 percent of the average daily flows exceeded 1,200 cfs and none were less than 923 cfs.

The population and flow data for the 1966-71 period suggest that the numbers and pounds of adult trout were substantially reduced by flows less than approximately 900-1,100 cfs. During this period, the highest trout populations were preceded by flows greater than approximately 1,200-1,400 cfs. Based on an evaluation of these data, the MDFWP has determined that a flow of at least 1,300 cfs is needed to maintain the high quality recreational fishery of Reach #4 of the Madison River at an acceptable level. A recommendation of 1,300 cfs, while not the most desired flow, is a reasonable request when considering the exceptional recreational values and resulting economic benefits derived from the existing high quality trout fishery of the lower Madison River.

STREAM NAME: Black Sand Spring Creek

STREAM REACH: From Black Sand Spring to the South Fork Madison River-
0.7 miles

LOCATION: NE, Sec. 31, T13S, R5E to NW, Sec. 31, T13S, R5E

DESCRIPTION OF STREAM REACH:

Black Sand Spring Creek originates at Black Sand Spring and flows for 0.7 miles before entering the South Fork Madison River, a tributary to Hebgen Reservoir. The upper half of this low gradient, spring-fed creek passes through a wet, coniferous forest. Here, the creek is wide (about 60 ft on average), slow moving and very shallow. The lower creek narrows and deepens, meandering through dense willows before joining the South Fork. The substrate is mainly comprised of sand and fine gravel. Abundant deadfalls line the creek's channel, creating excellent habitat for young trout. The entire drainage is within the Gallatin National Forest. A Forest Service road provides access to the spring. Recreation is the major land use activity within the drainage.

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout, cutthroat trout.

FISHERY:

Black Sand Spring Creek is an important spawning and nursery tributary for rainbow and brown trout residing in Hebgen Reservoir. Rainbow trout spawners ascend the creek in spring, while brown trout spawn in fall. The creek supports an abundance of young trout, particularly brown trout, which rear there before migrating downstream to the reservoir.

As part of the MDFWP's continuing efforts to establish a reproducing cutthroat trout fishery and to improve the existing rainbow trout fishery in Hebgen Reservoir, Black Sand Spring Creek was planted in 1986 and 1987 with 10,000-20,000 young cutthroat and rainbow trout. These fish originate from wild, long-lived, lake-dwelling strains that, unlike the domesticated hatchery strains planted in the past, are capable of reproducing in the wild. These wild planters are expected to rear in the creek, move downstream to the reservoir to grow to adulthood and, when sexually mature at 3-5 years of age, return to Black Sand Spring Creek to spawn. The success of these imprint plants will not be known for a number of years.

In addition to providing spawning and rearing habitats for reservoir trout, the creek also supports resident populations of brown, rainbow and brook trout. Brown and rainbow trout in the 14-17 inch class are fairly common in the creek, while the few brook trout present rarely exceed 7 inches.

WILDLIFE:

From spring through fall, elk, an occasional mule deer and an excellent population of moose inhabit the Black Sand Spring Creek drainage. The drainage also winters from 20-40 elk and provides important winter range for moose.

The drainage is an important area for furbearers, with mink, beaver and otter the primary species of interest. The stream corridor also provides important winter habitat for bald eagles. Because Black Sand Spring Creek does not ice-over, a few waterfowl winter on the stream. Waterfowl and sandhill cranes nest along its shores during the spring-summer breeding season.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important spawning and nursery habitats for trout residing in Hebgen Reservoir; to maintain existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 18.7 cfs (13,538 A.F./yr)

Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in spring creeks be maintained for instream uses.

The base flow of Black Sand Spring Creek is about 18.7 cfs. This measurement was made in 1987 (on September 16), a record low water year for the region. A flow of 18.7 cfs is, therefore, requested from January 1-December 31. This flow should be sufficient to protect much of the creek's flow.

STREAM NAME: South Fork of the Madison River

STREAM REACH: From the confluence of Dry Canyon to Hebgen Reservoir-
12.9 miles

LOCATION: Sec. 30, T14S, R5E to Sec. 10, T13S, R4E

DESCRIPTION OF STREAM REACH:

The South Fork of the Madison River originates at the southern end of the Lower Hilgard Mountains of southwest Montana. The stream begins at an elevation of about 7,200 ft and flows approximately 16 miles before discharging into the South Arm of Hebgen Reservoir at an elevation of about 6,560 ft. The stream gradient averages 40 ft/mile. The mean width of the lower South Fork at low flow is 75 ft. Much of the stream meanders through a wet, willow-choked bottom. Sand and fine gravel comprise the bottom substrate. The South Fork drains an area of approximately 82 square miles.

Lands within the South Fork drainage are primarily used for recreation and some logging. Homesite development is occurring on private lands near the stream's mouth. Timber harvesting has occurred in the past and additional timber sales are proposed for the future. Recreational use is considered high. Recreational activities include hunting, sightseeing, snowmobiling, cross-country skiing and fishing. Access to the South Fork drainage is provided by several miles of USFS controlled road.

The USGS estimated the mean annual flow of the South Fork at 138.6 cfs (Horpestad, 1976), while the SCS (1976) estimated a mean annual flow of 200.0 cfs. Sub-surface water sources, which contribute a significant portion of the flow, produce fairly stable, year-round flows in the South Fork.

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, cutthroat trout, brook trout.

FISHERY:

A 7,920 ft section of the South Fork near the confluence with Hebgen Reservoir was electrofished in August, 1970 (Vincent, 1971a). The brown trout was the predominant trout species in the section. Rainbow trout comprised less than 2% of the trout captured and brook trout were present in very low numbers. Mountain whitefish were also present in the section but not enumerated.

The standing crop of brown trout in the section was estimated using a mark-recapture method (Table 2-115). The estimate shows that this section supported about 1,393 brown trout, weighing 108 pounds, per 1,000 ft of stream. The brown trout population consisted primarily of yearlings (96%), with few adults. This preponderance of yearlings demonstrates the importance of the South Fork as a spawning and nursery stream for the reservoir population of brown trout.

Table 2-115. Estimated standing crop of brown trout by age class for a 7,920 ft section of the South Fork of the Madison River (T13S, R5E, Sec. 30C, 31A, and 32B) on August 6, 1970. Eighty percent confidence intervals are in parentheses.

Species	Age Class	Mean Length (inches)	Per 1,000 ft	
			Numbers	Pounds
Brown trout	I+	4.7	1,333	
	II+	8.0	34	
	III+	12.0	11	
	IV+	16.5	10	
	V+ and older	18.7	5	
			1,393(+501)	108(±25)

Up until 1954 when spawn-taking stations were phased out, the MDFWP operated a fish trap on the South Fork for the purpose of collecting eggs and milt from reservoir rainbow and brown trout that ascended the river to spawn. The fertilized eggs were taken to a state hatchery where they were hatched and the young raised for release into other waters. Many millions of eggs were collected each year at the Hebgen Reservoir traps.

In the late 1970's, subsequent to the above population estimate, the MDFWP began a program in Hebgen Reservoir to establish a cutthroat trout fishery and to improve the existing rainbow trout fishery by planting wild stocks of fish. Unlike the domesticated strains planted in the past, these fish are capable of reproducing in the wild, thus contributing to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of cutthroat and rainbow trout documented for a number of reservoir tributaries. While the contribution of the South Fork has not been evaluated as yet, use by reservoir populations of cutthroat and, particularly, rainbow trout is believed significant.

WILDLIFE:

The South Fork Madison River drainage supports mule deer, moose and high numbers of elk from spring through fall. The drainage winters low numbers of elk and provides important winter range for moose. A low density mountain lion population is also present.

The South Fork is an important area for furbearers, with muskrat, beaver, mink, otter and marten the primary species of interest. The drainage is important to waterfowl as well, servicing as a stop-over area during their spring and fall migrations and as a nesting area (the lower river) for ducks and Canada geese during the summer breeding season. In addition, the river corridor provides important habitat for wintering bald eagles.

WETTED PERIMETER:

Five riffle cross-sections were established in a 239 ft section of the lower South Fork (Sec. 14BA, T13S, R4E). However, stable summer-fall flows prevented the collection of the field data needed to calibrate the WETP program. During site visits on June 28, July 30 and October 21, 1986, the measured flow was 221, 180 and 178 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain spawning and nursery habitats for brown, rainbow and cutthroat trout residing in Hebgen Reservoir; to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 92 cfs (66,605 A.F./yr)

Sub-surface inflows have a stabilizing influence on the annual flow regime of the South Fork Madison River, causing the stream to resemble a large spring-fed creek. Because flows are relatively stable year-round, the base flow of the South Fork, estimated at 92 cfs by the USGS, is requested.

STREAM NAME: Cougar Creek

STREAM REACH: From the Yellowstone National Park boundary to the mouth-
2.8 miles

LOCATION: Sec. 27, T12S, R5E to Sec. 21, T12S, R5E

DESCRIPTION OF STREAM REACH:

Cougar Creek (renamed Maple Creek in recent Yellowstone National Park surveys) originates in Yellowstone National Park in the western foothills of the White Peaks at an elevation of 7,372 ft and flows for about 25 miles before joining Duck Creek 1.8 miles upstream from Hebgen Reservoir. The 2.8 miles of Cougar Creek downstream from the Park boundary meanders at a low gradient through a wide, marshy, willow-choked riparian area before entering Duck Creek. Lands surrounding this section are within the Gallatin National Forest. Beaver activity is extensive in this area. The stream, which averages about 11 ft in width, has a substrate of sand and gravel, with large deposits of sand and gravel at point bars. Cougar Creek drains an area of about 53 square miles.

The Cougar Creek drainage is extensively used by grizzly bears. The danger posed by bears limits summer recreational use along the Forest portion of the creek. Within the Park, recreational use is low and access is by foot. Forested areas along the lower creek have been logged in the past, creating large clearcuts.

Horpestad (1976) estimated the mean annual water yield for the Cougar Creek drainage at 24,000 acre-feet (33.2 cfs).

GAME FISH PRESENT: Brook trout, brown trout, rainbow trout.

FISHERY:

Cougar Creek within Yellowstone National Park supports robust populations of brook and brown trout. An upper tributary, which ends in a wet meadow before joining the mainstem, supports a pure population of native westslope cutthroat trout, the only such documented population remaining in the Park. Downstream from the Park, the brook trout is the predominant species, followed by brown and rainbow trout.

Cougar Creek likely serves as a reproductive site for brown and rainbow trout from Hebgen Reservoir. Due to the danger posed by grizzly bears, the creek has not been electrofished to assess spawning use. However, spawning runs have been documented in Duck Creek, to which Cougar Creek is a tributary. Similar spawning use likely occurs in Cougar Creek as well. Young rainbow trout fry have been dip-netted from Cougar Creek in recent years, suggesting that the stream serves as a reproductive site for this species.

WILDLIFE:

From spring through fall, elk, an occasional mule deer and an excellent population of moose inhabit the portion of the Cougar Creek drainage outside of Yellowstone National Park. This area winters from 20-40 elk, provides

important winter range for moose and, in winter and spring, is used by buffalo from the Park. This segment of the drainage is within occupied grizzly bear range as well, serving from February through November as a feeding and day-bedding area and an important travel corridor.

The Cougar Creek drainage is an important area for furbearers, with mink, beaver and otter the major species of interest. The stream corridor also provides important winter habitat for bald eagles. Canada geese nest along the lower creek. A few blue grouse reside in the drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain probable spawning and nursery habitats for adult trout residing in Hebgen Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 24 cfs (17,375 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Cougar Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 51.5 cfs was estimated by the USGS for Cougar Creek. An instream flow of 24 cfs is, therefore, requested.

STREAM NAME: Duck Creek

STREAM REACH: From the Yellowstone National Park boundary to Hebgen Reservoir - 3.0 miles

LOCATION: Sec. 22, T12S, R5E to Sec. 20, T12S, R5E

DESCRIPTION OF STREAM REACH:

Duck Creek originates in Yellowstone National Park and flows for 3.2 miles between its sources (Campanula, Gneiss and Richards Creeks) and the Park boundary. Between the Park boundary and Highway 287, the creek has been impounded, forming shallow ponds. A number of homes are located along this privately owned section. Below the highway, the creek meanders for about 3 miles through a wide, marshy, willow-choked flat before discharging into Hebgen Reservoir. Lands along much of this stretch are within the Gallatin National Forest. The stream has a mean width of about 10 ft and a silt-sand-gravel substrate. Duck Creek drains an area of about 118 square miles. Cougar Creek, which joins Duck Creek at stream mile 1.8, is the only tributary that enters in Montana.

The portion of the Duck Creek drainage within Yellowstone National Park is highly used by grizzly bears and, as a result, has been closed to the public. Outside the Park, grizzly bear use is also high. Thus, summer recreational use of the drainage is limited due to the danger posed by bears.

Horpestad (1976) estimated the mean annual water yield of the Duck Creek drainage at 34,489 acre-feet (47.7 cfs).

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout, cutthroat trout.

FISHERY:

Within Yellowstone National Park, brook trout dominate the fishery of Duck Creek, followed by rainbow, brown and a few cutthroat trout. This section of stream was noted for producing large brown trout, some in the five pound class, when it was open to fishing before the closure. Outside the Park, brown and rainbow trout are the primary resident game fish, with the brown trout predominating.

In addition to supporting a resident fishery, Duck Creek also is a spawning and rearing tributary for rainbow and brown trout residing in Hebgen Reservoir. In the past, the MDFWP operated a fish trap in Duck Creek for the purpose of collecting eggs and milt from rainbow and brown trout spawners ascending the creek. The fertilized eggs were taken to a state hatchery where the young were raised for release into other waters.

Spawning runs have not been intensely monitored in Duck Creek since the trapping program was discontinued in 1954. Recent efforts of the MDFWP to improve the rainbow trout fishery and establish a cutthroat trout fishery in Hebgen Reservoir by planting wild stocks of fish have rekindled interest in assessing tributary use by spawners.

On June 20, 1986, a short stretch of Duck Creek was electrofished and 13 rainbow trout spawners captured, indicating that Duck Creek continues to be used as a reproductive site by this species. Use of Duck Creek by spawning cutthroat trout may occur in the future as the reservoir population builds. Good numbers of reservoir brown trout continue to spawn in Duck Creek each fall.

WILDLIFE:

From spring through fall, elk, an occasional mule deer and an excellent population of moose inhabit the portion of the Duck Creek drainage outside of Yellowstone National Park. This area winters from 20-40 elk, provides important winter range for moose and, in winter and spring, is used by buffalo from the Park. This segment of the drainage is within occupied grizzly bear range as well, serving from February through November as a feeding and day-bedding area and an important travel corridor.

The Duck Creek drainage is an important area for furbearers, with mink, beaver and otter the major species of interest. The stream corridor also provides important winter habitat for bald eagles. Canada geese nest along the lower creek. A few blue grouse reside in the drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning and nursery habitats for rainbow, brown and possibly cutthroat trout residing in Hebgen Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 23 cfs (16,651 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Duck Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 49.4 cfs was estimated by the USGS for Duck Creek. An instream flow of 23 cfs is, therefore, requested.

STREAM NAME: Grayling Creek

STREAM REACH: From the Yellowstone National Park boundary to Hebgen Reservoir - 4.7 miles

LOCATION: Sec. 10, T12S, R5E to Sec. 18, T12S, R5E

DESCRIPTION OF STREAM REACH:

Grayling Creek originates in the northwest corner of Yellowstone National Park and flows in a southwesterly direction for approximately 26 miles before discharging into Hebgen Reservoir. It drains an area of about 73 square miles. The stream gradient averages about 61.5 feet per mile and channel widths range from 3-50 ft.

The floodplain of the 2.5 miles of stream upstream from the mouth is vegetated primarily with willow, aspen and some sagebrush. The remaining 23.5 miles of stream flow through a coniferous forest interspersed with marshy areas.

The lower 4.7 miles of stream outside of the Park pass through public (Gallatin National Forest) and private lands. A dude ranch and a few private houses are located along this stretch.

Recreational activities in the Grayling Creek drainage include back-packing, hiking, snowmobiling, cross-country skiing, hunting and fishing. Portions of the drainage within the Gallatin National Forest were logged from 1968-75. Highway 191, which traverses the Forest and Yellowstone Park, and logging roads provide access into the drainage.

Flow information is limited for Grayling Creek. Between 1960 and 1976, various state and federal agencies have measured flows at the Highway 287 bridge near the stream mouth. These measurements ranged from about 20 cfs in October, 1960 to nearly 1,100 cfs in May, 1972. The USGS (Horpestad, 1976) estimated the mean annual flow for Grayling Creek at 80 cfs, while the SCS (1976) estimated the mean annual flow at 103 cfs.

GAME FISH PRESENT: Rainbow trout, brown trout, cutthroat trout, rainbow x cutthroat hybrids, mountain whitefish, brook trout.

FISHERY:

Two fish population surveys were conducted on Grayling Creek in 1980. A 1,000 ft section near the stream mouth (T12S, R5E, Sec. 17B) was electro-fished on August 14, 1980. Game fish captured in descending order of abundance were brown, rainbow and brook trout. The mottled sculpin was the only non-game species collected. The electrofishing survey data are summarized in Table 2-116. Due to a combination of high flows and deep water, electrofishing efficiency was low and few fish were captured.

Table 2-116. Summary of electrofishing survey data collected for a 1,000 ft section of Grayling Creek (T12S, R5E, Sec. 17E) on August 14, 1980.

Fish Species	Number Captured	Length Range (inches)
Brown trout	3	3.2 - 7.1
Rainbow trout	2	4.0 - 6.3
Brook trout	1	8.2
Mottled sculpin	-	-

A second 1,000 ft section (T12S, R5E, Sec. 10A) was electrofished on August 1 and 13, 1980 in conjunction with a USFS stream habitat improvement study. Game fish captured in descending order of abundance were rainbow trout and rainbow x cutthroat hybrids, brown trout, cutthroat trout, mountain whitefish and brook trout. The mottled sculpin was the only non-game species captured. The electrofishing survey data are summarized in Table 2-117.

Table 2-117. Summary of electrofishing survey data collected for a 1,000 ft section of Grayling Creek (T12S, R5E, Sec. 10A) on August 1 and 13, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout and rainbow x cutthroat hybrids	55	3.2 - 10.1
Brown trout	15	5.4 - 17.8
Cutthroat trout	11	3.3 - 5.6
Mountain whitefish	3	7.0
Brook trout	1	7.3
Mottled sculpin	-	-

The standing crop of trout in the section was estimated using a mark-recapture method (Table 2-118). The estimate shows that this 1,000 ft section supported about 123 trout (3.2 inches and longer), weighing 8 pounds. Fifteen brown trout and one brook trout captured in the section are not included in the estimate.

Table 2-118. Estimated standing crop of trout in a 1,000 ft section of Grayling Creek (T12S, R5E, Sec. 10A) on August 1, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout, cutthroat trout and rainbow x cutthroat hybrids	3.2 - 5.9	104	
	6.0 - 9.9	16	
	10.0 - 10.1	3	
		123(±38)	8(±2)

In 1979, the MDFWP began a program to establish a reproducing cutthroat population in Hebgen Reservoir to diversify angling opportunities. Reservoir tributaries, including Grayling Creek, received imprint plants of young McBride cutthroat trout - a wild strain originating at McBride Lake in Yellowstone National Park. These fish were expected to rear in the streams, move to the reservoir to grow to adulthood and, when sexually mature at 3-5 years of age, return to their "natal" streams to spawn.

On May 23 and June 20, 1986, a mile-long section of lower Grayling Creek was electrofished to evaluate the success of the cutthroat plants. A total of 94 spawners - 16 cutthroat trout and 78 rainbow trout - were captured, indicating that adult cutthroat and rainbow trout from Hebgen Reservoir are utilizing Grayling Creek as a reproductive site. In addition, Grayling Creek also supports a substantial fall spawning run of brown trout. The creek contributes young recruits of three trout species - brown, rainbow and cutthroat trout - to the Hebgen Reservoir fishery.

WILDLIFE:

Big game species found in the Grayling Creek drainage are elk, mule deer, moose, black bear, grizzly bear and cougar. Resident upland game birds include ruffed and blue grouse. Furbearers include mink, marten, weasel, wolverine, coyote, fox, badger, lynx and bobcat.

WETTED PERIMETER:

Cross-sectional measurements were made in a 240 ft riffle-pool sequence located near stream mile 1.0 (T12S, R5E, Sec. 8C). Six cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 49.5, 91.3, 143.7, 265.7 and 466.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-109. Lower and upper inflection points occur at approximate flows of 18 and 34 cfs, respectively.

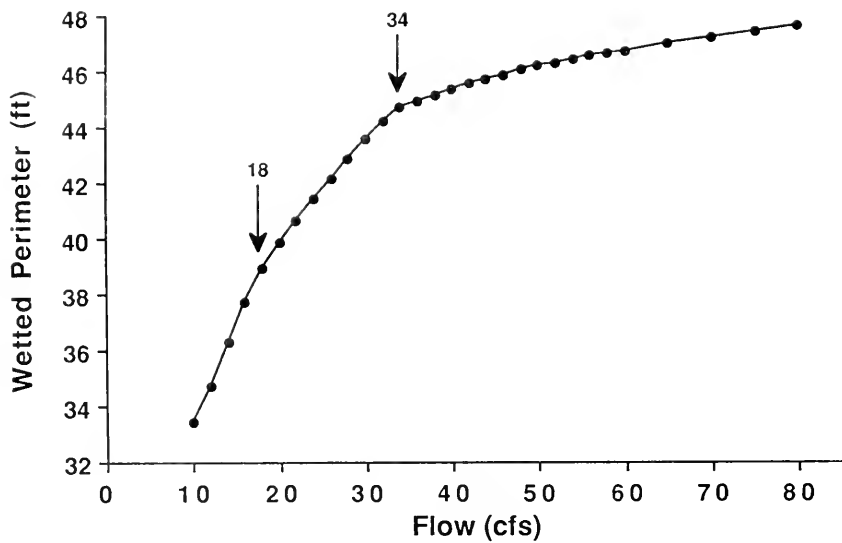


Figure 2-109. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Grayling Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide spawning and nursery habitats for brown, rainbow and cutthroat trout residing in Hebgen Reservoir; to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 34 cfs (24,615 A.F./yr)

STREAM NAME: Red Canyon Creek

STREAM REACH: From the headwaters to Hebgen Reservoir - 5.4 miles

LOCATION: Sec. 24, T11S, R4E to Sec. 11, T12S, R4E

DESCRIPTION OF STREAM REACH:

Red Canyon Creek arises in the Hilgard Mountains of southwest Montana and flows for about 5.4 miles before discharging into Hebgen Reservoir. The upper 3.7 miles of stream, which are entirely within the Gallatin National Forest, pass through a narrow valley containing coniferous stands and patches of grassy meadows. The lower 1.7 miles flow through privately owned, open, grazing lands that are vegetated with grasses and sagebrush. Here, livestock have removed much of the streamside willows, leaving bare and eroding banks. At low flow, Red Canyon Creek averages about 3 ft in width, with widths ranging up to about 8 ft. The stream has an unstable, gravel-cobble substrate that is extensively silted throughout its length. Natural erosion in this relatively undeveloped drainage has contributed to the instream sediment accumulations. A gravel road from Highway 287 provides public access into the drainage.

Lands within the drainage are primarily used for livestock grazing (on private lands) and recreation. Limited logging has occurred in the past. The drainage is popular with hunters, particularly during the spring and fall black bear seasons. A recreational development (Ski Yellowstone), consisting of a ski area, condominiums and marina, is proposed for both private and public lands within the drainage.

Upon leaving the National Forest, flow in Red Canyon Creek begins seeping into the bottom gravels. During low water years, the creek below the Forest is often completely dry during the non-runoff months.

GAME FISH PRESENT: Cutthroat trout, rainbow trout.

FISHERY:

In the late 1970's, the MDFWP began a program in Hebgen Reservoir to establish a cutthroat trout fishery and to improve the existing rainbow trout fishery by planting wild stocks of fish. Unlike the domesticated strains planted in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of cutthroat and rainbow trout documented for a number of reservoir tributaries, including Red Canyon Creek.

On June 19, 1986, an approximate 1,000 ft section of Red Canyon Creek within the National Forest was electrofished. A total of 44 spawners- 42 cutthroat and 2 rainbow trout, ranging to 17.7 inches - were captured. Cutthroat trout spawners and a few spawning rainbow trout were again captured during the 1987 run. Red Canyon Creek appears to be a major spawning tributary for the reservoir cutthroat population. Its importance as a

reproductive site will likely increase in the future as the reservoir cutthroat population continues to build.

Red Canyon Creek also supports a few small rainbow trout and a sparse population of small (3-7.5 inches) cutthroat trout. These fish were spawned in Red Canyon Creek, where they will likely rear for up to 2 years before moving downstream to the reservoir. Some may also be lifelong residents of the creek.

WILDLIFE:

The Red Canyon Creek drainage supports elk and a limited number of mule deer from spring through fall and a year-round population of moose. Up to 150 elk winter within the drainage. The drainage is important to black bears during all seasons, serving as a denning, bedding and feeding area. Grizzly bears seasonally occupy the area from February through November and may den there as well. Other wildlife species present include marten, mink, an occasional bobcat and a few mountain lion. Blue grouse and an occasional ruffed grouse are the upland game birds within the drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain important spawning and nursery habitats for cutthroat trout residing in Hebgen Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.9 cfs (2,100 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Red Canyon Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 6.1 cfs was estimated by the USGS for Red Canyon Creek. An instream flow of 2.9 cfs is, therefore, requested.

STREAM NAME: Watkins Creek

STREAM REACH: From the confluence of Coffin Creek to Hebgen Reservoir-
3.9 miles

LOCATION: Sec. 26, T12S, R3E to Sec. 8, T12S, R4E

DESCRIPTION OF STREAM REACH:

Watkins Creek originates in the Lower Hilgard Mountains of southwest Montana and flows in a northeasterly direction for about 5 miles before discharging into Hebgen Reservoir. Stream elevations at the origin and mouth are approximately 8,800 and 6,560 ft, respectively. The stream gradient averages about 448 ft/mile. Watkins Creek drains an area of about 11.4 square miles.

The lower $\frac{1}{2}$ mile of stream below the Gallatin National Forest passes through a privately owned, sagebrush flat that is grazed by cattle. Vegetation within the narrow riparian zone consists of willows and a few conifers. Overuse by cattle has damaged the streamside vegetation, producing raw and eroding banks along stretches of the lower stream.

Recreational activities in the drainage include hunting, backpacking, trail biking and fishing. Public access is via a USFS road located on the southern shore of Hebgen Reservoir. Foot and horse trails serve the remainder of the drainage. At present, there is no logging activity within the drainage. However, a future timber sale is proposed.

The mean annual flow for Watkins Creek was estimated by the USGS (Horpestad, 1976) at 3.4 cfs (2,497 acre-feet). Water to irrigate grazing lands is diverted from lower Watkins Creek during the summer.

GAME FISH PRESENT: Rainbow trout, cutthroat trout.

FISHERY:

A 513 ft section of lower Watkins Creek (T12S, R4E, Sec. 7D) was electrofished on October 17, 1980. A 1,000 ft section could not be surveyed because numerous deadfalls within the channel hindered the electrofishing effort. Thirty-three rainbow trout from 3.3-9.2 inches were captured. The mottled sculpin was the only non-game species present. The population of rainbow trout, which averaged 4.7 inches in length, was too sparse to estimate using the mark-recapture method.

In the late 1970's, the MDFWP began a program in Hebgen Reservoir to establish a cutthroat trout fishery and to improve the existing rainbow trout fishery by planting wild stocks of fish. Unlike the domesticated strains planted in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of cutthroat and rainbow trout documented for a number of reservoir tributaries.

A short section of lower Watkins Creek was electrofished on June 20, 1986 to assess spawning use. Three spawners - two rainbow trout and one

cutthroat trout - were captured, indicating that reservoir trout are utilizing Watkins Creek as a reproductive site. Based on the results of an electrofishing survey conducted on May 18, 1988, at least 100 rainbow trout were estimated to have spawned in the lower ½ mile of Watkins Creek in 1988. A beaver dam at the ½ mile mark presently blocks spawner access to the upper stream.

Efforts of the MDFWP to further build the cutthroat trout population in Hebgen Reservoir continue. In 1986 about 6,000-8,000 young McBride cutthroat trout - a wild strain originating in McBride Lake in Yellowstone Park - were planted in Watkins Creek in an attempt to improve future spawning runs. These young fish are expected to rear in the creek, move downstream to Hebgen Reservoir to grow to adulthood and, when sexually mature at 3-5 years of age, return to their "natal" stream to spawn. The success of this imprint plant will not be known for a few more years.

WILDLIFE:

From spring through fall, elk, mule deer and moose inhabit the Watkins Creek drainage. A few moose remain year-round, wintering within the area. Black bears are present in good numbers, while grizzly bears are rare. Bighorn sheep and an occasional mountain goat occupy the headwaters year-round. Other wildlife species present include mink, bobcat, wolverine, marten and a few mountain lion. The blue grouse is the primary upland game bird within the drainage.

WHY FLOW IS NECESSARY:

The requested flow is necessary to sustain the existing resident trout population; to maintain spawning and nursery habitats for rainbow and cutthroat trout residing in Hebgen Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5.5 cfs (3,982 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Watkins Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 11.8 cfs was estimated by the USGS for Watkins Creek. An instream flow of 5.5 cfs is, therefore, requested.

STREAM NAME: Trapper Creek

STREAM REACH: From the headwaters to Hebgen Reservoir - 2.2 miles

LOCATION: Sec. 11, T12S, R3E to Sec. 36, T11S, R3E

DESCRIPTION OF STREAM REACH:

Trapper Creek originates in the Lower Hilgard Mountains of southwest Montana and cascades through a coniferous forest for 2.2 miles before discharging into Hebgen Reservoir. The entire drainage is within the Gallatin National Forest. Trapper Creek has a boulder-cobble-gravel substrate and, at low flow, a mean width of about 8 ft.

The major land use within the drainage is recreation. No harvesting of timber has occurred since the 1940's, although a future sale is being proposed. An old logging road provides access into the drainage.

GAME FISH PRESENT: Rainbow trout, cutthroat trout.

FISHERY:

In the late 1970's, the MDFWP began a program in Hebgen Reservoir to establish a cutthroat trout fishery and to improve the existing rainbow trout fishery by planting wild stocks of fish. Unlike the domesticated strains planted in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of cutthroat and rainbow trout documented for a number of reservoir tributaries, including Trapper Creek.

On May 15, 1987, MDFWP personnel walked the lower 1,000 ft of Trapper Creek, observing 10 pair of spawners and about 20-30 redds. On June 12, 1987 the same section was electrofished. Even though the peak of the run was long over by this date, a few rainbow and cutthroat trout spawners were captured, indicating that both species are utilizing Trapper Creek as a reproductive site. Based on the results of an electrofishing survey conducted on May 19 and June 3, 1988, at least 500 rainbow trout were estimated to have spawned in the lower ¼ mile of Trapper Creek in 1988. Upstream sections were unsurveyed.

Efforts of the MDFWP to further build the cutthroat trout population in Hebgen Reservoir continue. In 1986, young, wild, McBride cutthroat trout were planted in Trapper Creek in an attempt to improve future spawning runs. These young fish are expected to rear in Trapper Creek, move downstream to Hebgen Reservoir to grow to adulthood and, when sexually mature at 3-5 years of age, return to their "natal" stream to spawn. The success of this imprint plant will not be known for a number of years.

Electrofishing surveys show that Trapper Creek also supports a few resident rainbow and cutthroat trout, which reach lengths up to about 7 inches.

WILDLIFE:

From spring through fall, elk, mule deer and moose inhabit the Trapper Creek drainage. A few moose remain year-round, wintering within the area. Black bears are present in good numbers, while grizzly bears are rare. Bighorn sheep occasionally occupy the head of the drainage. A low density population of mountain lions is also present. Other wildlife species present include mink, bobcat, wolverine, marten and blue grouse.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain spawning and nursery habitats for rainbow and cutthroat trout residing in Hebgen Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.2 cfs (2,317 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Trapper Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 6.9 cfs was estimated by the USGS for Trapper Creek. An instream flow of 3.2 cfs is, therefore, requested.

STREAM NAME: Cabin Creek

STREAM REACH: From the confluence of Gully Creek to the Madison River-
5.5 miles

LOCATION: Sec. 5, T11S, R4E to Sec. 15, T11S, R3E

DESCRIPTION OF STREAM REACH:

Cabin Creek arises in the Taylor-Hilgard Mountains of southwest Montana and flows in a southwesterly direction for about 8 miles before joining the Madison River about 2 miles upstream from Earthquake Lake. Stream elevations at the origin and mouth are about 8,400 and 6,470 ft, respectively. The stream gradient averages approximately 241 ft/mile and channel widths range from about 4-25 ft. Cabin Creek drains an area of about 30 square miles, all within Forest Service lands.

Until 1963, the primary non-recreational land use within the Cabin Creek drainage was the grazing of domestic sheep. After 1963, stock grazing was eliminated. Recreation, most notably big game hunting, is now the predominant activity within the drainage. Other recreational activities include backpacking, trailbiking, snowmobiling, horseback riding and fishing.

The Cabin Creek drainage is presently roadless. Two USFS trails, which traverse the drainage, receive only light use. No logging or mining are known to have occurred in the drainage. However, deposits of copper and good quality limestone are present.

The USFS has operated a gage on Cabin Creek since 1971. Flow data are available for the months of May through October for the years 1971-80. The gage is located near the Highway 287 bridge near the mouth. The maximum and minimum flows of record are 1,280 cfs (May, 1971) and 5.3 cfs (October, 1976), respectively. Approximate mean monthly flows of record ranged from 15 cfs (for October) to 362 cfs (for June). Steve Glasser, hydrologist for the Gallatin N.F., estimated the mean annual flow at 39.7 cfs (28,741 acre-feet).

The USGS has operated a crest-stage gage near the mouth of Cabin Creek since 1974. The maximum flow recorded was 585 cfs (in 1983).

GAME FISH PRESENT: Rainbow trout, brown trout, cutthroat trout.

FISHERY:

A 1,000 ft section of Cabin Creek was electrofished on July 16 and 22, 1980. Game fish captured in descending order of abundance were rainbow and brown trout. Cutthroat trout, which have been reported in Cabin Creek and its tributaries by other investigators, were not collected during this survey. Non-game species captured were longnose sucker and mottled sculpin. The electrofishing survey data are summarized in Table 2-119. The standing crop of trout was too sparse to estimate using the mark-recapture method.

Table 2-119. Summary of electrofishing survey data collected for a 1,000 ft section of Cabin Creek (T11S, R3E, Sec. 15D) on July 16 and 22, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	6	3.9 - 6.2
Brown trout	2	3.8 - 5.0
Longnose sucker	1	14.7
Mottled sculpin	-	-

Cabin Creek is believed to provide spawning and nursery habitats for the rainbow, brown and cutthroat trout populations of Earthquake Lake. The lake sport fishery is wholly maintained by the natural reproduction that occurs in Cabin Creek and other lake tributaries, including the Madison River. The value of Cabin Creek as a reproductive site for the Earthquake Lake trout population far outweighs its value as a resident trout fishery. However, the magnitude of this spawning use has not yet been evaluated in electrofishing studies.

WILDLIFE:

The Cabin Creek drainage supports populations of elk, mule deer, moose, black bear, cougar, mountain goat and bighorn sheep. High densities of elk and moose are found in the drainage during the period from early summer through fall. The drainage also contains important habitat for grizzly bear. Small populations of mountain goat and bighorn sheep are associated with adjacent foothills and peaks. Resident upland game birds are ruffed and blue grouse. Furbearers include mink, marten, bobcat, beaver and wolverine.

WETTED PERIMETER:

Cross-sectional measurements were made in a 123 ft riffle-run sequence located near stream mile 0.2 (T11S, R3E, Sec. 15D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 30.6, 53.7 and 102.7 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-110. Lower and upper inflection points occur at approximate flows of 11 and 22 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to sustain the existing resident trout populations; to maintain spawning and nursery habitats for trout residing in Earthquake Lake; to help maintain adequate fishery flows in the upper Madison River (see FLOW REQUEST for an explanation); and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

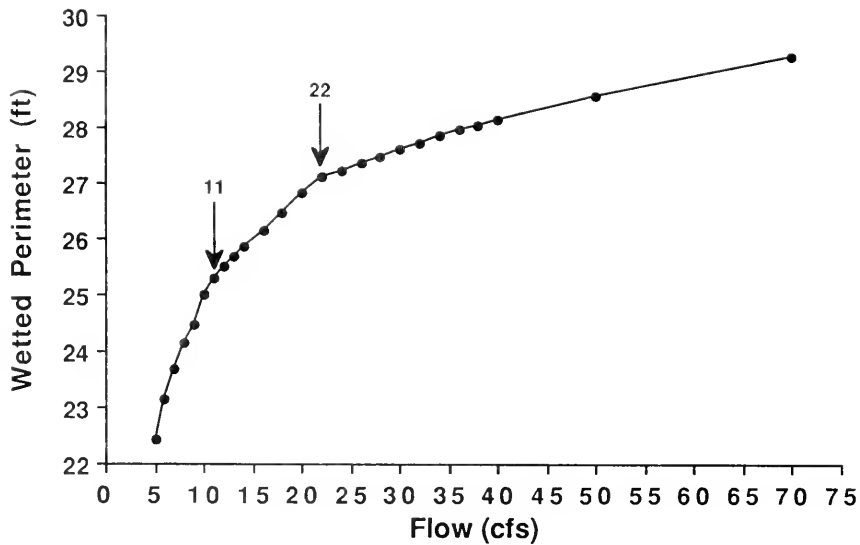


Figure 2-110. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Cabin Creek.

FLOW REQUEST: January 1-December 31 -- 585 cfs (28,741 A.F./yr)

The flow request for Cabin Creek was based on the flow management plan for the Madison River rather than the wetted perimeter inflection point method. A description of this plan and pertinent background information follows.

Flows in the Madison River are regulated at Hebgen Reservoir, which stores water for downstream hydro-electric generation. The present water management plan for the reservoir, which was formulated through a cooperative agreement between the Montana Power Company (the operator of Hebgen Dam), the U.S. Forest Service and the Montana Department of Fish, Wildlife and Parks, calls for a minimum flow release of 50 cfs when Hebgen Reservoir is filled during the snow runoff period from about May 15 to July 15. Prior to the initiation of the plan in 1968, the reservoir was filled during late winter and early spring, the period when the natural flows of the river are lowest for the year. As a result, the entire 100 miles of free-flowing river below Hebgen Dam were severely dewatered from February through April. Electrofishing data collected by the MDFWP confirmed that this winter dewatering substantially reduced trout populations throughout the river.

The management plan has eliminated the winter dewatering problem because water is no longer stored during the February through April period, thereby allowing winter flow releases to approximate the natural condition. During the runoff period when the reservoir is filled and releases are greatly reduced, only the river fishery between Hebgen Dam and Earthquake Lake is jeopardized because the runoff flows of the tributaries to the upper river insure that dewatering does not occur in the remaining 97 miles of river. The plan basically compromises the trout fishery in the 3 miles of the Madison River between Hebgen Dam and Earthquake Lake in order to protect the fishery in the remaining 97 miles.

The tributaries to the upper Madison River are essential for maintaining an acceptable flow in the upper river during the runoff period when Hebgen Reservoir is filled. In some years, drought conditions or abnormal seasonal flow patterns may require a temporary modification of this water management plan. Consequently, the tributaries may become an essential water source in other than the normal snow runoff period. To protect this crucial water supply, it is recommended that all unappropriated waters in the major tributaries to the upper Madison River (Beaver Creek, Cabin Creek and the West Fork Madison River) be maintained instream for the period of January 1 through December 31. For Cabin Creek, this recommendation amounts to about 28,741 acre-feet of water in an average year. Because this need is most critical during the snow runoff period when Hebgen Reservoir is filled, a flow rate of 585 cfs, the maximum flow of record at the USGS crest gage site, is requested.

STREAM NAME: Beaver Creek

STREAM REACH: From the confluence of Wyethia Creek to Earthquake Lake-
7.2 miles

LOCATION: Sec. 21, T10S, R3E to Sec. 21, T11S, R3E

DESCRIPTION OF STREAM REACH:

Beaver Creek originates in the Taylor-Hilgard Mountains of southwest Montana and flows in a southerly direction for about 11.3 miles before discharging into Earthquake Lake on the Madison River. It drains an area of about 53 square miles, all within National Forest lands. From the headwaters at about 8,880 ft to the mouth at about 6,460 ft the stream gradient averages 214 ft/mile.

Between the mouth and stream mile 5.9, the stream flows through a sparsely forested, marshy floodplain vegetated with lodgepole pine, Douglas fir, willows and aspen. Numerous log jams, floodplain debris piles and unstable banks have created a multi-channel streambed. Excessive bedload movement has been observed in this section. The stream gradient is approximately 59 ft/mile and channel widths range from about 20-60 ft.

The section between stream mile 5.9 and the headwaters lies within a steep valley vegetated with lodgepole pine and Douglas fir. Numerous log jams and bankside debris piles are present. The stream gradient averages about 373 ft/mile and channel widths range from about 4-25 ft.

The two principal activities in the Beaver Creek drainage are logging and recreation. Some logging has occurred in the eastern half of the drainage during the last 20 years, but is now limited to salvage operations. Sheep were grazed in the drainage from 1960-62.

Approximately 8 miles of controlled-access road serve the eastern half of the drainage. The western half is undeveloped with limited access. USFS trails provide access to the entire drainage. Major recreational activities include big game hunting (September-November), backpacking, fishing and snowmobiling. Although no mining has occurred in the Beaver Creek drainage, deposits of copper have been found and some prospecting for mica has occurred.

The Beaver Creek drainage had the second largest recorded sediment production on the Gallatin National Forest between 1975 and 1980. A combination of natural channel erosion and logging roads east of Patomageton Park are believed to be the source of this sediment.

From 1971-80, the USFS operated a gage on Beaver Creek at the Highway 287 bridge. Approximate mean monthly flows of record for the months of April through October ranged from 60 cfs (for October) to 300 cfs (for June). The maximum and minimum flows for the period of record were 937 cfs (June, 1971) and 34 cfs (April, 1977), respectively. The SCS (1976) estimated the mean annual water yield for the Beaver Creek drainage at 54,000 acre-feet (74.6 cfs). Steve Glasser, hydrologist for the Gallatin N.F., estimated the mean annual flow at stream mile one at 58.4 cfs (42,280 acre-feet).

GAME FISH PRESENT: Rainbow trout, brown trout, cutthroat trout.

FISHERY:

A 1,000 ft section of Beaver Creek (T11S, R3E, Sec. 16A) was electro-fished on August 21, 1980. Ten rainbow trout from 3.0-7.0 inches and 4 longnose suckers were captured. The population of trout in this section was too sparse to estimate using the mark-recapture method.

Beaver Creek is believed to provide spawning and nursery habitats for the rainbow, brown and cutthroat trout populations of Earthquake Lake. The lake sport fishery is wholly maintained by the natural reproduction that occurs in Beaver Creek and other lake tributaries. The value of Beaver Creek as a spawning tributary for Earthquake Lake far outweighs its resident fishery value. However, the magnitude of this spawning use has not yet been evaluated in electrofishing studies.

WILDLIFE:

The upper Beaver Creek drainage provides excellent summer range for moose and elk. Two important elk winter migration routes traverse the upper drainage. Small numbers of mountain goat and bighorn sheep use adjacent slopes and peaks. Resident upland game birds are ruffed and blue grouse. Furbearers include mink, marten, bobcat, weasel, coyote, badger and wolverine.

Big game animals found in the lower drainage include elk and mule deer. Black bear are occasionally seen during the summer and early fall months. Moose commonly winter along the stream. The beaver is the principal furbearer in the area. Other furbearers include mink, marten, weasel, coyote and bobcat. The entire drainage is within designated grizzly bear range.

WETTED PERIMETER:

Cross-sectional measurements were made in a 231 ft riffle-pool sequence located near stream mile 1.2 (T11S, R3E, Sec. 16D). Eight cross-sections were established. The WETP program was calibrated to field data collected at flows of 61.9, 103.8 and 141.0 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-111. Lower and upper inflection points occur at approximate flows of 16 and 22 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to sustain the existing resident trout population; to maintain spawning and nursery habitats for migrant trout from Earthquake Lake; to help maintain adequate fishery flows in the upper Madison River (see FLOW REQUEST for an explanation); and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

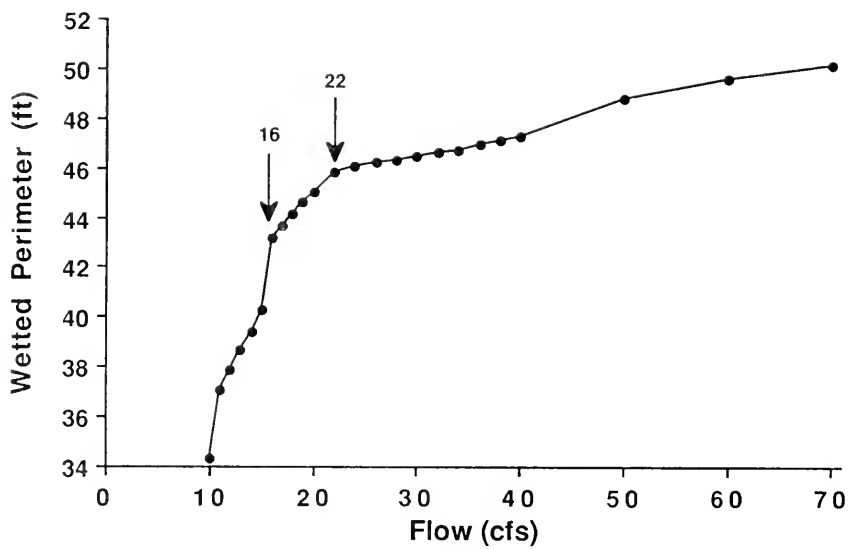


Figure 2-111. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Beaver Creek.

FLOW REQUEST: January 1-December 31 -- 937 cfs (42,280 A.F./yr)

The flow request for Beaver Creek is based on the flow management plan for the Madison River rather than the wetted perimeter inflection point method. A description of this plan and pertinent background information follow.

Flows in the Madison River are regulated at Hebgen Reservoir, which stores water for downstream hydro-electric generation. The present water management plan for the reservoir, which was formulated through a cooperative agreement between the Montana Power Company (the operator of Hebgen Dam), the U.S. Forest Service and the Montana Department of Fish, Wildlife and Parks, calls for a minimum flow release of 50 cfs when Hebgen Reservoir is filled during the snow runoff period from about May 15 to July 15. Prior to the initiation of the plan in 1968, the reservoir was filled during late winter and early spring, the period when the natural flows of the river are lowest for the year. As a result, the entire 100 miles of free-flowing river below Hebgen Dam were severely dewatered from February through April. Electrofishing data collected by the MDFWP confirmed that this winter dewatering substantially reduced trout populations throughout the river.

The management plan has eliminated the winter dewatering problem because water is no longer stored during the February through April period, thereby allowing winter flow releases to approximate the natural condition. During the runoff period when the reservoir is filled and releases are greatly reduced, only the river fishery between Hebgen Dam and Earthquake Lake is jeopardized because the runoff flows of the tributaries to the upper river insure that dewatering does not occur in the remaining 97 miles of river. The plan basically compromises the trout fishery in the 3 miles of the Madison River between Hebgen Dam and Earthquake Lake in order to protect the fishery in the remaining 97 miles.

The tributaries to the upper Madison River are essential for maintaining an acceptable flow in the upper river during the runoff period when Hebgen Reservoir is filled. In some years, drought conditions or abnormal seasonal flow patterns may require a temporary modification of this water management plan. Consequently, the tributaries may become an essential water source in other than the normal snow runoff period. To protect this crucial water supply, it is recommended that all unappropriated waters in the major tributaries to the upper Madison River (Beaver Creek, Cabin Creek and the West Fork Madison River) be maintained instream for the period of January 1 through December 31. For Beaver Creek, this recommendation amounts to about 42,280 acre-feet of water in an average year. Because this need is most critical during the snow runoff period when Hebgen Reservoir is filled, a flow rate of 937 cfs, the maximum flow of record, is requested.

STREAM NAME: Antelope Creek

STREAM REACH: From the headwaters to the mouth - 8.5 miles

LOCATION: Sec. 32, T13S, R2E to Sec. 25, T12S, R1E

DESCRIPTION OF STREAM REACH:

Antelope Creek originates on the north slope of the Henrys Lake Mountains of southwest Montana. It flows in a northerly direction for about 8.5 miles before discharging into Cliff Lake, a natural 700 acre lake within the Beaverhead National Forest. Except for a 1.5 mile strip about 3 miles above the mouth, lands surrounding Antelope Creek are in public ownership. Stream elevations at the origin and mouth are 7,680 and 6,320 ft, respectively. The stream gradient averages 160 ft/mile and the stream width near the mouth averages about 15.4 ft.

Much of the land surrounding Antelope Creek consists of timber stands interspersed in sagebrush-grass rangeland. Stock grazing is the major land use activity in the drainage.

Recreational activities within the drainage include hunting, fishing, and horseback riding. The USFS maintains three developed campgrounds in the immediate area along Cliff and Wade Lakes. Access to Antelope Creek is by boat (via Cliff Lake) or motor vehicle via a single lane road.

GAME FISH PRESENT: Rainbow trout.

FISHERY:

A 1,000 ft section of Antelope Creek was electrofished on July 9 and 24, 1980. One hundred fifteen rainbow trout, ranging from 2.1-16.0 inches, and 6 white suckers were captured.

The standing crop of rainbow trout in the section was estimated using a mark-recapture method (Table 2-120). The estimate shows that this 1,000 ft section supported about 247 rainbow trout (3.0 inches and longer), weighing 54 pounds.

Table 2-120. Estimated standing crop of rainbow trout in a 1,000 ft section of Antelope Creek (T12S, R1E, Sec. 36A) on July 9, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.0 - 5.9	115	
	6.0 - 9.9	105	
	10.0 - 16.0	27	
		247(±76)	54(±13)

In addition to supporting a fairly substantial resident trout population, Antelope Creek also provides crucial spawning and nursery habitats for the rainbow trout population of Cliff Lake. The popular sport fishery of the lake is wholly maintained by the natural reproduction that occurs in Antelope Creek and other tributaries.

WILDLIFE:

From spring through late fall, the Antelope Creek drainage supports seasonal populations of antelope, mule deer and elk. Moose are occasional year-round inhabitants of the drainage. Resident furbearers include mink and coyote. The primary game birds within the basin are blue and sage grouse.

WETTED PERIMETER:

Cross-sectional measurements were made in a 102 ft riffle-run sequence located near stream mile 0.2 (T12S, R1E, Sec. 36A). Seven cross-sections were established. The site was visited on May 29, July 1, 9 and 24, and September 9, 1980. During this period, the flow of Antelope Creek remained stable at 14.2-15.3 cfs. Consequently, the collection of the field data needed for calibrating the WETP program could not be completed.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident rainbow trout population; to maintain spawning and nursery habitats for rainbow trout residing in Cliff Lake; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

Antelope Creek appears to be spring-fed and not appreciably influenced by snow-melt. Spring creeks receive special consideration in the instream flow program of the MDFWP. Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana.

It is, therefore, recommended that the base flow of Antelope Creek remain instream for the maintenance of fish and wildlife habitat. Based on limited stream flow data, this recommendation amounts to an approximate flow of 14 cfs (10,136 acre-feet of water per year).

STREAM NAME: Elk River

STREAM REACH: From the headwaters to the mouth - 14.7 miles

LOCATION: Sec. 9, T11S, R2W to Sec. 17, T12S, R1E

DESCRIPTION OF STREAM REACH:

The Elk River originates in the Gravelly Range and flows southeast for 14.7 miles before entering the West Fork of the Madison River, which then flows for 8.6 miles before discharging into the Madison River. The Elk River drains an area of about 41 square miles, all within the Beaverhead National Forest. The grazing of cattle and sheep is the predominant land use along the river. Some logging also occurs.

GAME FISH PRESENT: Rainbow trout, brown trout, rainbow x cutthroat hybrid trout, cutthroat trout.

FISHERY:

Two 500 ft sections of the Elk River located about 2 and 14 miles above the confluence with the West Fork were electrofished. In the lower section, the river flows through an open forest and has a moderate channel gradient. In the upper (headwater) section, the river is relatively small, has a low gradient and passes through a dense willow bottom.

Game fish captured in descending order of abundance were rainbow trout, brown trout, rainbow x cutthroat hybrids, and cutthroat trout. A total of 40 trout were collected. It is doubtful if any genetically pure westslope cutthroat trout exist in the river due to the predominance of rainbow trout throughout the river's length. Average lengths of captured brown trout and rainbow trout in the lower section were 6.1 and 6.4 inches, respectively. Trout captured in the upper section averaged 9.6 inches. Population estimates were not possible in either section.

The presence of relatively large numbers of juvenile rainbow and brown trout in the lower study section suggests that the Elk River may provide important spawning and rearing habitats for mainstem Madison River rainbow and brown trout.

WILDLIFE:

The Elk River drainage provides important habitat for a number of big game species, especially elk. Elk utilize the drainage for calving and summer foraging. The rugged forests surrounding the Elk River are particularly noted for providing high security habitat for elk during the fall hunting season. Important summer-fall range for mule deer as well as year-round habitat for black bear and moose are also found within the drainage. Other resident species of importance include bobcat, mountain lion and various raptors, including bald and golden eagles.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to protect possible spawning and rearing habitats for brown and rainbow trout from the Madison River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 28 cfs (20,271 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for the Elk River. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 60.2 cfs was estimated by the USGS for the Elk River. An instream flow of 28 cfs is, therefore, requested.

STREAM NAME: West Fork of the Madison River

STREAM REACH: From the confluence of Fox Creek to the mouth - 31.2 miles

LOCATION: Sec. 14, T12S, R3W to Sec. 10, T11S, R1E

DESCRIPTION OF STREAM REACH:

The West Fork of the Madison River originates on the east slope of the southern portion of the Gravelly Mountains in southwest Montana. It flows in an easterly direction for about 34 miles before discharging into the Madison River. Stream elevations at the origin and mouth are approximately 9,060 and 5,910 ft, respectively. The stream gradient averages approximately 93 ft/mile and stream widths range from 3-80 ft. The West Fork drains an area of about 220 square miles, much of which is within the Beaverhead National Forest.

The West Fork is considered to be a major contributor of sediment to the Madison River. A 1970 study estimated that over 10 tons of sediment, of which 47% came from the immediate stream banks, is annually discharged into the Madison River (Lisle, 1972). This sediment problem is a direct result of extensive grazing damage on the surrounding slopes. Grazing has occurred since the late 1800's. At present, there are grazing allotments for sheep, cattle and horses.

The West Fork drainage has approximately 30 miles of road regulated by the USFS. There are also countless miles of closed jeep trails and maintained trails. These corridors provide excellent access to the back country and maintained campsites. Recreational activities within the drainage include big game hunting (September-November), fishing, snowmobiling, hiking, camping and sightseeing.

The USGS intermittently operated a gage on the West Fork at stream mile 0.2 from 1959-67. The mean, maximum and minimum flows for the period of record were 91.9, 957 and 21.0 cfs, respectively. Mean monthly flows ranged from 37.9 cfs (for December) to 299 cfs (for June).

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, cutthroat trout.

FISHERY:

Fish population estimates were made in a 2,640 ft section of the West Fork near its mouth in August, 1971 and August, 1972 (Vincent, 1973). These estimates are summarized in Table 2-121. The rainbow trout was the most abundant trout species, comprising 68% of the trout numbers in both 1972 and 1973.

The 1972 estimate showed that this section supported about 251 salmonids (rainbow trout, brown trout and mountain whitefish), weighing 87 pounds, per 1,000 feet of stream. Rainbow and brown trout accounted for 84% of the total game fish by number and 47% by weight.

Table 2-121. Estimated standing crops of game fish in a 2,640 ft section of the West Fork of the Madison River (T11S, R1E, Sec. 10D) in August of 1971 and 1972. Eighty percent confidence intervals are in parentheses.

Species	Age-Class	Mean Length (inches)	<u>August 1971</u>	
			<u>Per 1,000 ft</u>	
			Numbers	Pounds
Rainbow trout	I+	6.1	128	
	II+	8.2	49	
	III+	10.8	5	
	IV+ & Older	16.4	<u>1</u>	
			183(±74)	27(±8)
Brown trout	I+	6.4	46	
	II+	9.3	27	
	III+	13.5	11	
	IV+ & Older	17.7	<u>1</u>	
			85(±28)	27(±8)
Total trout			268(±79)	54(±11)
<u>August 1972</u>				
Rainbow trout	I+	5.9	123	
	II+	8.6	13	
	III+ & Older	12.8	<u>7</u>	
			143(±23)	19(±3)
Brown trout	I+	6.1	35	
	II+	8.8	21	
	III+	13.0	11	
	IV+ & Older	16.1	<u>1</u>	
			68(±13)	22(±5)
Mountain whitefish	II+	11.7	6	
	III+ & Older	14.9	<u>34</u>	
			40(±17)	46(±20)
Total Game Fish			251(±31)	87(±21)

On August 31, 1987, Brad Shepard, fishery biologist on the Beaverhead National Forest, electrofished the upper West Fork near its headwaters (T12S, R3W, Sec. 24A). The study section supported an estimated 15 (± 2 at an 80% CI) westslope cutthroat trout from 3.0-5.9 inches and 15 (± 2 at an 80% CI) westslope cutthroat trout 6.0 inches and longer, weighing a total of 4.8 pounds, per 1,000 ft of stream. Identification of these cutthroat trout was based on external morphological characteristics. Electrophoretic analysis would be needed to verify their genetic purity.

Two other sections have been electrofished by the MDFWP to determine species composition. The game fish population in the section 11 miles upstream from the mouth consisted of 82% cutthroat trout, 12% rainbow trout and 6% brown trout. In the section 6 miles upstream from the mouth, the population consisted of 73% rainbow trout, 20% brown trout and 7% cutthroat trout.

In addition to supporting resident game fish, the West Fork also provides some spawning and nursery habitats for rainbow and brown trout inhabiting the Madison River. Spawning runs of both species enter the West Fork. However, the magnitude of these runs has not been evaluated in electrofishing surveys.

WILDLIFE:

The West Fork drainage provides important summer range for elk and mule deer. The willow covered floodplain serves as winter range for moose. Grizzly bears are occasionally sighted in the drainage. Other resident big game species are black bear and mountain lion. Furbearers include beaver, mink, marten, weasel, bobcat, coyote, badger and wolverine. Ruffed and blue grouse are the resident game birds. Use of the West Fork by waterfowl is limited.

WETTED PERIMETER:

Cross-sectional measurements were made in a 226 ft riffle-run sequence located near stream mile 0.8 (T11S, R1E, Sec. 10D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 67.3, 93.0 and 181.0 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-212. Lower and upper inflection points occur at approximate flows of 22 and 42 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to sustain existing resident trout populations, which may include westslope cutthroat trout - a species of "special concern" in Montana; to maintain spawning and nursery habitats for migrant trout from the Madison River; to help maintain adequate fishery flows in the upper Madison River (see FLOW REQUEST for an explanation); and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

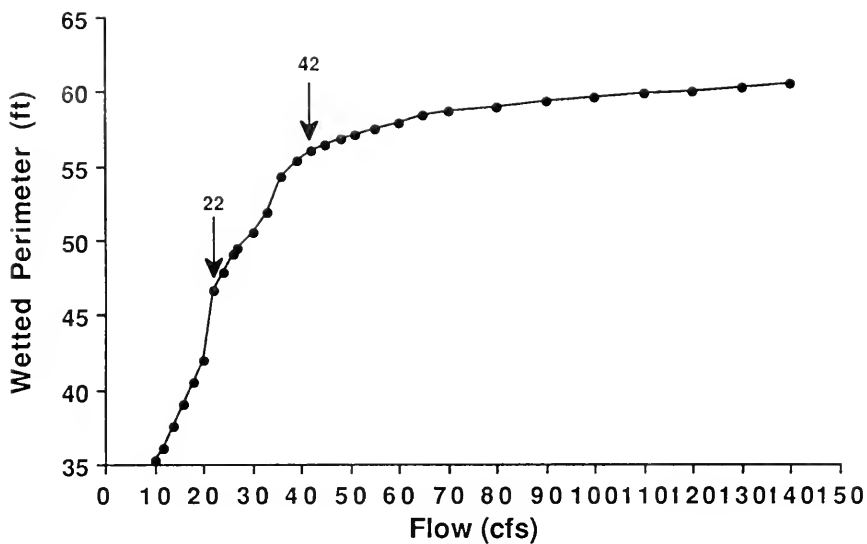


Figure 2-112. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in the West Fork of the Madison River.

FLOW REQUEST: January 1-December 31 -- 957 cfs (66,533 A.F./yr)

The flow request for the West Fork was derived from the flow management plan for the Madison River rather than the wetted perimeter inflection point method. A description of this plan and pertinent background information follow.

Flows in the Madison River are regulated at Hebgen Reservoir, which stores water for downstream hydro-electric generation. The present water management plan for the reservoir, which was formulated through a cooperative agreement between the Montana Power Company (the operator of Hebgen Dam), the U.S. Forest Service and the Montana Department of Fish, Wildlife and Parks, calls for a minimum flow release of 50 cfs when Hebgen Reservoir is filled during the snow runoff period from about May 15 to July 15. Prior to the initiation of the plan in 1968, the reservoir was filled during late winter and early spring, the period when the natural flows of the river are lowest for the year. As a result, the entire 100 miles of free-flowing river below Hebgen Dam were severely dewatered from February through April. Electrofishing data collected by the MDFWP confirmed that this winter dewatering substantially reduced trout populations throughout the river.

The management plan has eliminated the winter dewatering problem because water is no longer stored during the February through April period, thereby allowing winter flow releases to approximate the natural condition. During the runoff period when the reservoir is filled and releases are greatly reduced, only the river fishery between Hebgen Dam and Earthquake Lake is seriously jeopardized because the runoff flows of the tributaries to the upper river insure that dewatering does not occur in the remaining 97 miles of river. The plan basically compromises the trout fishery in the 3 miles of the Madison River between Hebgen Dam and Earthquake Lake in order to protect the fishery in the remaining 97 miles.

The tributaries to the upper Madison River are essential for maintaining an acceptable fishery flow in the upper river during the runoff period when Hebgen Reservoir is filled. In some years, drought conditions or abnormal seasonal flow patterns may require a temporary modification of this water management plan. Consequently, the tributaries may become an essential water source in other than the normal snow runoff period. To protect this crucial water supply, it is recommended that all unappropriated waters in the major tributaries to the upper Madison River (Beaver Creek, Cabin Creek and the West Fork Madison River) be maintained instream for the period of January 1 through December 31. For the West Fork, this recommendation amounts to about 66,533 acre-feet of water in an average year. Because this need is most critical during the snow runoff period when Hebgen Reservoir is filled, a flow rate of 957 cfs, the maximum flow of record, is requested.

STREAM NAME: Standard Creek

STREAM REACH: From the headwaters to the mouth - 12.5 miles

LOCATION: Sec. 34, T10S, R2W to Sec. 33, T10S, R1E

DESCRIPTION OF STREAM REACH:

Standard Creek originates on the east slope of the Gravelly Mountain Range in southwest Montana. The stream heads at an elevation of about 9,300 ft and flows in an easterly direction for about 13 miles before discharging into the Madison River at an elevation of about 5,800 ft. The stream gradient averages approximately 269 ft/mile. Standard Creek drains an area of about 23 square miles, virtually all of which is within the Beaverhead National Forest.

The floodplain is moderately sloped and forested with conifers interspersed in sagebrush-grass meadows. A half mile series of beaver ponds is located near stream mile 4.0. The width of the stream channel ranges from about 3-30 ft. The channel is considered stable. Instream debris is found throughout the stream length, becoming very dense in places.

Land use activities are limited primarily to grazing and some timber harvesting. Sheep and cattle grazing has occurred throughout the drainage. Logging operations began in the mid-1960's. The U.S. Steel Corporation is planning to mine iron ore from the drainage sometime in the future. Major recreational activities include hunting, fishing, firewood gathering and camping. The drainage is served by about 9 miles of controlled access road. Several miles of logging roads and skid trails also provide access.

Water resource information is limited for Standard Creek. Sporadic flow measurements collected by the USFS in 1976-78 ranged from 14 to 141 cfs. The USFS estimated the low and high flows, based on miscellaneous flow measurements for the period of August 1972-July 1978, at 5 and 92 cfs, respectively. The 25 and 50 year peak instantaneous flows were estimated by the SCS (1976) at 275 and 316 cfs, respectively.

GAME FISH PRESENT: Rainbow x cutthroat hybrids, westslope cutthroat trout, brown trout, arctic grayling.

FISHERY:

A 1,000 ft section of Standard Creek was electrofished on July 23 and August 8, 1980. Sixty-three rainbow x cutthroat hybrid trout from 4.7-12.0 inches and one 9.8 inch brown trout were captured. No other species were present.

The standing crop of hybrid trout in the section was estimated using a mark-recapture method (Table 2-122). The estimate shows that this 1,000 ft section supported about 115 trout (4.7 inches and longer), weighing 15 pounds.

Table 2-122. Estimated standing crop of rainbow x cutthroat hybrids in a 1,000 ft section of Standard Creek (T11S, R1W, Sec. 12B) on July 23, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow x cutthroat hybrids	4.7 - 5.9	46	
	6.0 - 9.9	67	
	10.0 - 12.0	2	
		115(±45)	15(±6)

In 1988, Brad Shepard, fishery biologist on the Beaverhead National Forest, found westslope cutthroat trout in Standard Creek (Sec. 11, T11S, R1W) at an estimated density of 254 fish 3.0 inches and longer per 1,000 ft of stream. Cutthroat ranged to 9.1 inches in length. In addition to cutthroat trout, Haugen (1975) captured one arctic grayling (9.5 inches) in a section of Standard Creek within 3.1 miles of the mouth. The fact that Standard Creek sustains a viable population of westslope cutthroat trout and may still support a few stream-dwelling grayling - both of which are species of "special concern" in Montana - warrants maximum flow protection.

WILDLIFE:

Big game species found in the Standard Creek drainage include elk, mule deer, moose, black bear and cougar. Upland game birds are ruffed and blue grouse. Furbearers include beaver, mink, weasel, coyote, badger and wolverine.

WETTED PERIMETER:

Cross-sectional measurements were made in a 41 ft riffle-run sequence located near stream mile 3.7 (T11S, R1W, Sec. 12B). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 18.2, 28.0 and 62.9 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-113. Lower and upper inflection points occur at approximate flows of 6 and 10 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident salmonid population, which includes species of "special concern"; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 10 cfs (7,240 A.F./yr)

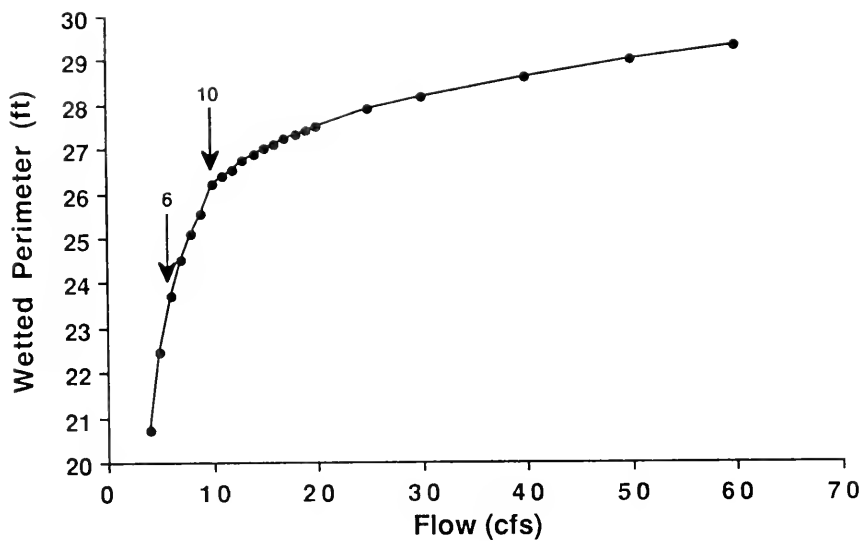


Figure 2-113. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Standard Creek.

STREAM NAME: Squaw Creek

STREAM REACH: From the confluence of the North Fork to the mouth - 4.7 miles

LOCATION: Sec. 19, T10S, R2E to Sec. 33, T10S, R1E

DESCRIPTION OF STREAM REACH:

Squaw Creek arises from several lakes on the west slope of the Madison Range of southwest Montana and flows in a southwesterly direction for about 9.2 miles before discharging into the Madison River. It drains an area of approximately 22 square miles. The stream elevations decrease by about 3,760 ft between the headwaters (9,600 ft) and the mouth (5,840 ft). The gradient averages about 409 ft/mile and stream widths range from about 4.5 to 20 ft.

Private landowners, which border USFS lands, severely restrict recreational use within the Squaw Creek drainage. Big game hunting followed by hiking and fishing are the principal recreational activities. Fishing pressure for Squaw Creek and its tributaries is considered light, while pressure on the headwater alpine lakes is moderate.

Flow data are limited for the Squaw Creek drainage. Instantaneous flows measured by the USGS near the mouth in August, 1961 and October, 1972 were 12.6 and 17.2 cfs, respectively. The SCS (1976) estimated the 25 and 50 year instantaneous peak flows at 375 and 431 cfs, respectively.

GAME FISH PRESENT: Brown trout, rainbow trout.

FISHERY:

A 1,000 ft section of lower Squaw Creek at stream mile one was electro-fished on July 29 and August 8, 1980. Seventy-seven brown trout, ranging from 3.7-14.9 inches, and 47 rainbow trout from 3.3-11.2 inches were captured. The mottled sculpin was the only non-game species present.

The standing crops of brown and rainbow trout were estimated using a mark-recapture method (Table 2-123). The estimates show that this 1,000 ft section supported about 175 trout, weighing 34 pounds. Brown trout, the predominant trout species, accounted for 63% of the total trout numbers and 71% of the biomass. For a mountain stream of its size, Squaw Creek supports a fairly substantial trout population.

Table 2-123. Estimated standing crop of trout in a 1,000 ft section of Squaw Creek (T10S, R1E, Sec. 34D) on July 29, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	5.5 - 5.9	19	
	6.0 - 9.9	83	
	10.0 - 14.9	<u>8</u>	
		110(±36)	24(±8)
Rainbow trout	3.3 - 5.9	28	
	6.0 - 9.9	35	
	10.0 - 11.2	<u>2</u>	
		65(±17)	10(±3)
Total trout		175(±40)	34(±9)

WILDLIFE:

The Squaw Creek drainage supports resident and/or transient populations of elk, mule deer, moose, black bear, grizzly bear, mountain goat and bighorn sheep. Moose winter along the stream bottom and bighorn sheep winter on the lower elevations of the basin. Upland game birds in the drainage include ruffed and blue grouse. Furbearers include mink, marten, bobcat, wolverine and weasel.

WETTED PERIMETER:

Cross-sectional measurements were made in a 98 ft riffle-run sequence located near stream mile 1.5 (T10S, R1E, Sec. 34D). Five cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 5.6, 30.8 and 49.3 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-114. Lower and upper inflection points occur at approximate flows of 5 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

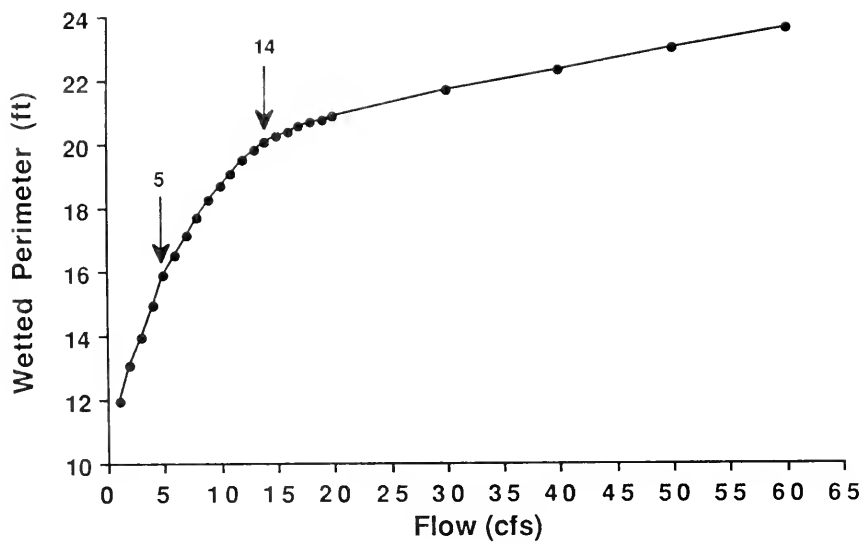


Figure 2-114. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Squaw Creek.

STREAM NAME: Ruby Creek

STREAM REACH: From the confluence of Beartrap Canyon to the mouth-
8.2 miles

LOCATION: Sec. 25, T9S, R2W to Sec. 12, T9S, R1W

DESCRIPTION OF STREAM REACH:

Ruby Creek originates on the east slope of the Gravelly Mountain Range of southwest Montana. The stream heads at an elevation of about 8,800 ft then flows in an easterly direction for about 11 miles before discharging into the Madison River at an approximate elevation of 5,520 ft. The stream gradient averages about 305 ft/mile and channel widths range from 2 to 20 ft. Ruby Creek drains an area of approximately 33 square miles.

Ruby Creek lies almost entirely on public lands. Except for a 0.1 mile section of stream on private lands, the lower 3.5 miles of Ruby Creek flow through the Wall Creek Game Range, which is administered by the Montana Department of Fish, Wildlife and Parks. The remaining 7.5 miles are within the Beaverhead National Forest. The BLM maintains a popular campground and picnic area near the mouth.

Water resource information is limited for Ruby Creek. Sporadic flow measurements taken by the USFS for the months of May-September, 1976-77, ranged from 8 to 49 cfs. The SCS (1976) estimated the instantaneous 25 and 50 year peak flows at 295 and 339 cfs, respectively. In 1966, 0.4 miles of Ruby Creek were critically affected by dewatering during the summer irrigation season (Wipperman, 1967). Existing irrigation diversions still severely dewater a portion of the lower creek from August to mid-September.

Major land use activities in the drainage are grazing and timber harvesting. Recreational activities include hunting, hiking, camping and fishing.

GAME FISH PRESENT: Rainbow trout.

FISHERY:

A 1,000 ft section of Ruby Creek was electrofished on July 10 and August 28, 1980. During this survey, 256 rainbow trout from 2.9-11.0 inches were captured. No other species were present.

The standing crop of rainbow trout in the section was estimated using a mark-recapture method (Table 2-124). The estimate shows that this 1,000 ft section supported about 523 rainbow trout 3.5 inches and longer, weighing 40 pounds.

Table 2-124. Estimated standing crop of rainbow trout in a 1,000 ft section of Ruby Creek (T9S, R1W, Sec. 16C and 17D) on July 10, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.5 - 5.9	380	
	6.0 - 9.9	137	
	10.0 - 11.0	<u>6</u>	
		523(±118)	40(±6)

For a mountain stream of its size, Ruby Creek supports a fairly substantial trout population.

WILDLIFE:

Lands surrounding lower Ruby Creek provide important winter range for elk and mule deer. About 500 of each species winter on the Wall Creek Game Range. A few moose winter along the stream bottom. Other big game species within the drainage are white-tailed deer, black bear, antelope and mountain lion. Resident upland game birds are ruffed and blue grouse. Furbearers include beaver, mink, weasel, coyote, badger and wolverine.

WETTED PERIMETER:

Cross-sectional measurements were made in a 102 ft riffle-run sequence located near stream mile 3.8 (T9S, R1W, Sec. 16C and 17D). Six cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 10.2, 12.4, 21.2 and 41.4 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-115. Lower and upper inflection points occur at approximate flows of 7 and 18 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 18 cfs (13,031 A.F./yr)

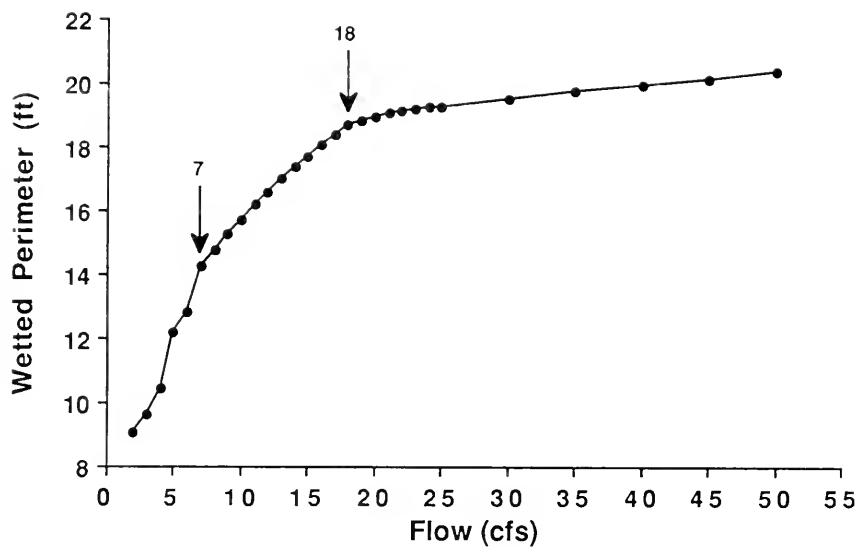


Figure 2-115. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Ruby Creek.

STREAM NAME: Indian Creek

STREAM REACH: From the confluence of Raw Liver Creek to the mouth - 14.7 miles

LOCATION: Sec. 19, T8S, R3E to Sec. 25, T8S, R1W

DESCRIPTION OF STREAM REACH:

Indian Creek arises on the west slope of the Madison Range and flows in a westerly direction for about 16.5 miles before discharging into the Madison River. Stream elevations at the origin and mouth are approximately 8,400 and 5,400 ft, respectively. The stream gradient averages 180 ft/mile. Indian Creek drains an area of about 74 square miles.

Primary activities within the Indian Creek drainage are ranching and recreation. Ranching is primarily limited to the lower one-third of the drainage with some stock grazing within the Forest Service boundary. Because the lower 5.5 miles of Indian Creek drainage lie entirely within private lands, public access to the upper drainage within the USFS boundary is severely restricted. Big game hunting (September through November) is the primary recreational use, followed by fishing and hiking.

The section of Indian Creek between the mouth and USFS boundary is approximately 5.5 miles in length with an average gradient of about 111 ft/mile. Stream widths range from 18-40 ft. This section is bordered by rangeland and irrigated crop, pasture and hay lands. The riparian vegetation includes cottonwood, aspen, willow and grasses. In some years, this lower section is totally dewatered during the months of July and August. During 1966, 5.8 miles of Indian Creek were severely or totally dewatered during the summer irrigation season (Wipperman, 1967).

The section of Indian Creek between the USFS boundary and the headwaters is approximately 10 miles in length. Stream elevations decrease from 8,400 ft at the headwaters to 6,040 ft at the USFS boundary. The gradient averages about 220 ft/mile and stream widths range from about 4-20 ft. Willow, aspen, conifers and grasses border the stream.

The SCS (1976) estimated the mean annual water yield for the Indian Creek drainage at 56,400 acre-feet (77.9 cfs).

GAME FISH PRESENT: Rainbow trout, brown trout.

FISHERY:

A 1,000 ft section of Indian Creek at the National Forest boundary was electrofished on August 21 and October 3, 1980. Ninety-eight rainbow trout, ranging from 3.0-12.9 inches, and two brown trout (10.8 and 11.3 inches) were captured. The mottled sculpin was the only non-game species present.

The standing crop of rainbow trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-125). The estimate shows that this 1,000 ft section supported about 157 rainbow trout (6.0 inches and longer), weighing 46 pounds. For a mountain stream of its

size, Indian Creek supports a fairly substantial resident rainbow trout population.

Table 2-125. Estimated standing crop of trout in a 1,000 ft section of Indian Creek (T8S, R1E, Sec. 26D) on August 21, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.0 - 5.9	a)	
	6.0 - 9.9	118	
	10.0 - 12.9	39	
		157(±46)	46(±12)

a) No estimate is available due to insufficient recaptures.

WILDLIFE:

Resident big game species along lower Indian Creek include pronghorn antelope and white-tailed deer. Mule deer winter along the west slope of the foothills bordering the stream.

The upper drainage supports resident and/or transient populations of elk, mule deer, black bear, grizzly bear, moose, cougar and mountain goat. A major elk migration route lies in the northeast portion of the upper drainage. Important furbearers include mink, marten, weasel, skunk, wolverine, fox, coyote, badger, bobcat, lynx and beaver. Resident game birds are ruffed and blue grouse.

WETTED PERIMETER:

Cross-sectional measurements were made in a 110 ft riffle-pool sequence located near stream mile 5.5 (T8S, R1E, Sec. 26D). Seven cross-sections were placed within this sequence. The WETP program was calibrated to field data collected at flows of 45.9, 71.3 and 88.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-116. Lower and upper inflection points occur at approximate flows of 22 and 48 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 48 cfs (34,750 A.F./yr)

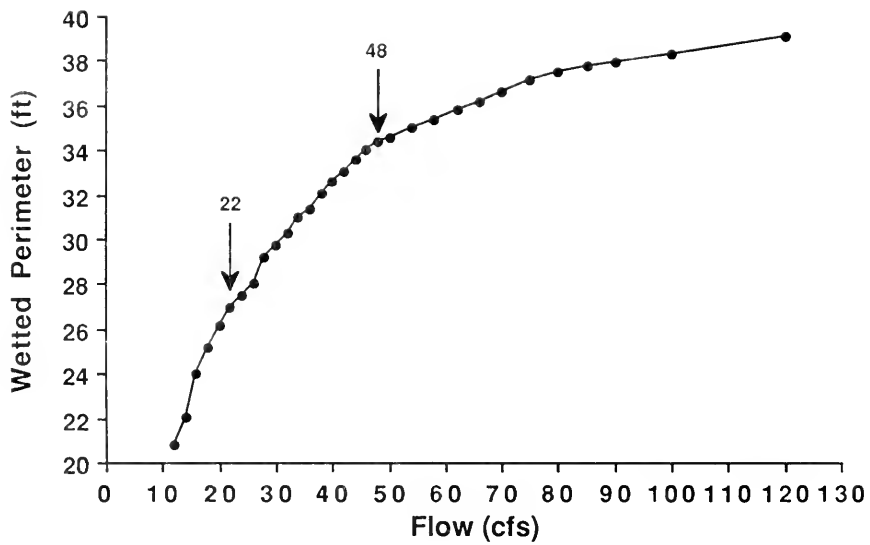


Figure 2-116. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Indian Creek.

STREAM NAME: Blaine Spring Creek

STREAM REACH: From the Ennis National Fish Hatchery to the mouth - 6.9 miles

LOCATION: Sec. 24, T7S, R2W to Sec. 20, T6S, R1W

DESCRIPTION OF STREAM REACH:

Blaine Spring Creek originates at two large springs about 0.5 miles upstream from the Ennis National Fish Hatchery and flows 7.4 miles before discharging into the Madison River. The two springs serve as the hatchery's water supply. After leaving the hatchery, the creek flows through private lands used primarily for grazing and hay and small grain production. Lands adjacent to the upper creek below the hatchery have been subdivided for residential development. The upper 2 miles of creek are fairly steep. Here, channel widths range from 8-20 ft and the substrate is comprised of gravel and cobble covered with mats of aquatic vegetation. Banks are densely vegetated with willows, grasses and forbs. The lower creek has a lower gradient, becoming a slow moving, meandering stream. Channel widths range from 15-40 ft. The substrate is comprised entirely of fine silt covered with large clumps of aquatic vegetation. The riparian zone is vegetated with willows, grasses and forbs and, along the lower mile of creek, cottonwoods.

Irrigation depletions impact the lower reaches of Blaine Spring Creek. Wiperman (1967) identified 2.3 miles of stream as being critically affected by dewatering.

The USGS operated a gage at about stream mile 6.8 of Blaine Spring Creek from August, 1971 to June, 1972. Daily flows during the period of record ranged from 14 to 37 cfs. For 8 of the 11 months of record, daily flows remained between 25 and 37 cfs. Mean monthly flows ranged from 14.6 cfs (in June, 1972) to 34.4 cfs (in February, 1972).

GAME FISH PRESENT: Brown trout, rainbow trout.

FISHERY:

A 1,000 ft section of lower Blaine Spring Creek was electrofished on July 29 and August 8, 1980. One hundred eighty-three brown trout, ranging from 3.7-16.2 inches, and 15 rainbow trout from 3.7-13.4 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of brown trout, the predominant game species in the section, was estimated using a mark-recapture method (Table 2-126). The estimate showed that this 1,000 ft section supported about 438 brown trout (7.0 inches and longer), weighing 239 pounds. The population of rainbow trout was too sparse to estimate using mark-recapture procedures.

Of the spring creeks evaluated in southwest Montana, Blaine Spring Creek ranks with the best in terms of the magnitude of its trout population.

Table 2-126. Estimated standing crop of brown trout in a 1,000 ft section of Blaine Spring Creek (T7S, R1W, Sec. 6) on July 29, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	7.0 - 9.9	152	
	10.0 - 16.2	<u>286</u>	
		438(±123)	239(±69)

WILDLIFE:

Antelope and white-tailed deer are the most important big game species within the Blaine Spring Creek drainage. Mule deer are also present. Furbearers using the creek and its riparian zone include mink, muskrat and beaver. Some waterfowl use occurs during the spring and fall migrations. Nesting waterfowl are blue-winged teal and mallard.

FLOW REQUEST: January 1-December 31 -- 23 cfs (16,651 A.F./yr)

Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in spring creeks be maintained for instream uses. For Blaine Spring Creek, the base flow, as estimated by the USGS, is 23 cfs.

STREAM NAME: O'Dell Spring Creek

STREAM REACH: From the headwaters to the mouth - 10.3 miles

LOCATION: Sec. 9, T7S, R1W to Sec. 27, T5S, R1W

DESCRIPTION OF STREAM REACH:

O'Dell Spring Creek is located on private lands within the upper Madison River valley. It flows in a northerly direction paralleling the Madison River for about 10.3 miles before entering the river at the MDFWP's Valley Garden Fishing Access Site. Much of the creek is within the Madison River floodplain and is subject to overflow from the river during extreme high water periods and extreme cold periods in December-February when ice jams cause flooding. Except for these periods, there is little seasonal variation in flow.

The vegetation on lands adjacent to the creek consists of cottonwoods, willows, alders, grasses and assorted small shrubs. The immediate streambank is of three types: heavily covered with willows and alder, open grassland, and open and eroding due to heavy livestock use. The stream has a pool-riffle sequence with fairly extensive areas of overhanging brush and undercut banks along some sections. The bottom type is cobble-gravel with fine silts covering about 50% of the substrate. Adjacent lands are primarily used for cattle grazing. Flooding prevents homesite and cropland development. There is one irrigation diversion about 50 ft below the Highway 289 bridge near Ennis. Access to the creek is controlled by private landowners and not readily available to the public.

Flow data for O'Dell Spring Creek is limited. Seven flows measured by the MDFWP between June 10 and June 20, 1969 at a site below the irrigation diversion at the Highway 289 bridge ranged from 77-109 cfs and averaged 95 cfs. On November 5, 1971 and October 3, 1972, the USGS measured flows of 139 and 143 cfs, respectively, at the Highway 289 bridge above the diversion.

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish, brook trout.

FISHERY:

Brown trout, rainbow trout, mountain whitefish and an occasional brook trout comprise the sport fish in O'Dell Spring Creek. Brown trout, the most abundant game species, reach weights of 5 pounds, but few exceed 3 pounds.

A series of brown trout population estimates are available for a 1.8-mile-long section of O'Dell Spring Creek for the period of 1967-1975 (Vincent, 1987). The latest estimate (in September, 1975) showed 253 brown trout age I+ and older (about 6 inches and longer), weighing 109 pounds, per 1,000 ft of stream.

The magnitude of the trout population in O'Dell Spring Creek is lower than expected for a spring creek of its size. This depressed population is believed to partly reflect the poor habitat conditions that characterized about 50% of the fish study section. Due to overuse by livestock, stream

banks were eroding and devoid of overhanging vegetation, creating a wide, shallow channel having limited overhead cover for trout.

WILDLIFE:

Big game animals found along O'Dell Spring Creek are moose, mule deer and white-tailed deer. Resident upland game birds include ruffed grouse, Hungarian partridge and an occasional ring-necked pheasant. Common furbearers inhabiting the drainage are beaver, muskrat and mink.

Use of the creek by ducks is extensive during the fall and winter months. Blue-winged teal and mallards commonly nest along the creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 98 cfs (70,949 A.F./yr)

Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in spring creeks be maintained for instream uses. For O'Dell Spring Creek, the base flow, as estimated by the USGS, is 98 cfs.

STREAM NAME: Jack Creek

STREAM REACH: From the confluence of Lone Creek to the mouth - 15.2 miles

LOCATION: Sec. 14, T6S, R2E to Sec. 23 and 14, T4S, R1W

DESCRIPTION OF STREAM REACH:

Jack Creek originates at Ulrey's Lakes on the west slope of the Madison Range and flows in a westerly direction for about 16 miles before joining the Madison River near Ennis, Montana. The drainage area is approximately 64 square miles. Between its headwaters and mouth, the stream elevation decreases from about 7,800 to 4,680 ft.

Much of the Jack Creek drainage lies within fragile geological soil formations, making this stream less tolerant to man caused disturbances (Matney and Garvin, 1978). Although water quality is rated good, spring runoff can produce high sediment yields.

The primary recreational use within the drainage is big game hunting (October-November). Fishing is of secondary importance.

Much of the lower 6 miles of Jack Creek is surrounded by irrigated hay and pasture lands. The gradient of this section averages 121 ft/mile and channel widths range from about 9 to 27 ft. This section is subject to severe dewatering and bank stabilization problems.

The upper 10 miles of Jack Creek pass through private timber lands owned by the Burlington Northern Railroad. Extensive timber harvesting is presently underway. Here, the gradient averages 238 ft/mile and channel widths range from about 5 to 30 ft. Streambank vegetation consists of cottonwood, aspen, willow and conifers.

The mean annual flow of Jack Creek, as measured at the USGS gage at stream mile 6.5, is 46.1 cfs. Extremes for the 6-year period of record (1973-79) ranged from 5.0-555 cfs. Mean monthly flows ranged from 13.1 cfs (for February) to 170.5 cfs (for June). This gage is located upstream from all major irrigation diversions and, therefore, reflects natural flow conditions.

GAME FISH PRESENT: Rainbow trout, brown trout.

FISHERY:

A 1,000 ft section of Jack Creek at about stream mile 6.5 was electrofished on August 20 and October 3, 1980. Game fish captured in descending order of abundance were rainbow and brown trout. Hatchery rainbow trout were also present in small numbers. The MDFWP annually planted Jack Creek with about 850 catchable-size rainbow trout until 1984 when stocking ceased. The mottled sculpin was the only non-game species collected. The electrofishing survey data are summarized in Table 2-127.

Table 2-127. Summary of electrofishing survey data collected for a 1,000 ft section of Jack Creek (T5S, R1E, Sec. 34D) on August 20 and October 3, 1980.

Fish Species	Number Captured	Length Range (inches)
Wild rainbow trout	120	3.5 - 14.8
Hatchery rainbow trout	6	8.1 - 11.1
Brown trout	2	11.3 - 16.8
Mottled sculpin	-	-

The standing crop of rainbow trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-128). The estimate shows that this 1,000 ft section supported about 214 rainbow trout, weighing 32 pounds. The six hatchery rainbow trout captured in the section are not included in the estimate.

Table 2-128. Estimated standing crop of rainbow trout in a 1,000 ft section of Jack Creek (T5S, R1E, Sec. 34D) on August 20, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.5 - 5.9	87	
	6.0 - 9.9	121	
	10.0 - 14.8	6	
		214(±48)	32(±6)

Despite the annual plants of domesticated hatchery fish, Jack Creek still supports a fairly substantial wild rainbow trout population for a mountain stream of its size. Now that stocking has ceased, the wild population is expected to expand beyond the 1980 population level.

WILDLIFE:

The lower Jack Creek drainage supports resident herds of pronghorn antelope and white-tailed deer and also serves as a wintering area for mule deer. The Hungarian partridge is the dominant upland game bird.

The upper drainage supports resident and/or transient populations of elk, mule deer, moose, mountain goat, bighorn sheep, black bear and cougar. Upland game birds within the upper drainage are ruffed and blue grouse.

Furbearers include mink, marten, weasel, skunk, red fox, coyote, badger, bobcat, lynx and beaver.

WETTED PERIMETER:

Cross-sectional measurements were made in a 112 ft riffle-run sequence located near stream mile 6.5 (T5S, R1E, Sec. 34D). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 41.6, 58.3 and 79.7 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-117. Lower and upper inflection points occur at approximate flows of 18 and 28 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 28 cfs (20,271 A.F./yr)

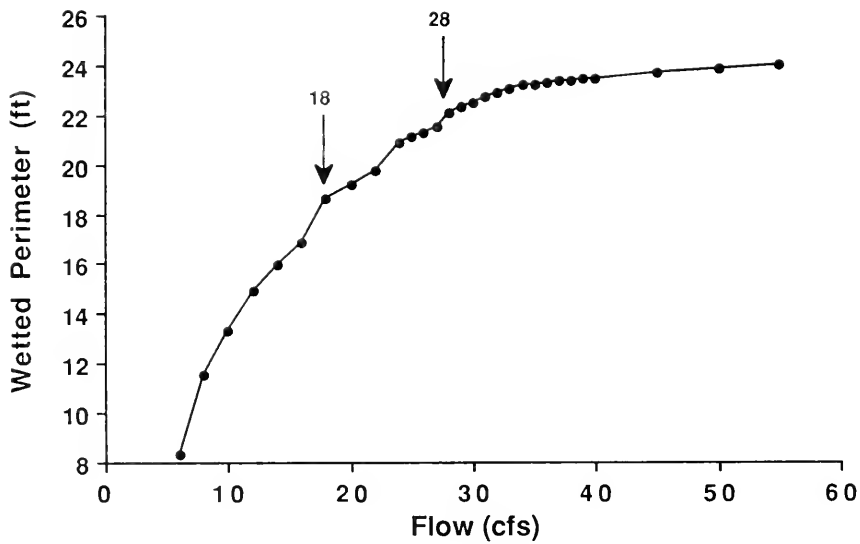


Figure 2-117. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Jack Creek.

STREAM NAME: Moore Creek

STREAM REACH: From the confluence of Fletcher Creek to the mouth - 10.9 miles

LOCATION: Sec. 26, T5S, R2W to Sec. 15, T5S, R1W

DESCRIPTION OF STREAM REACH:

Moore Creek originates in the foothills of the Tobacco Root Mountains of southwest Montana. Much of the creek above the town of Ennis passes through a dry, wide canyon. Below Ennis, the creek enters the Madison Valley and meanders through wet, grassy pasture lands before discharging into the Madison River about one mile upstream from Ennis Reservoir. Total stream length is 14.6 miles.

Grazing is the major land use activity within the drainage. Home site development has occurred on adjacent lands in Ennis and near the lower creek. Commercial use of existing geothermal wells in the lower drainage is slated for the future.

GAME FISH PRESENT: Brook trout, brown trout, arctic grayling.

FISHERY:

A 550 ft section of Moore Creek immediately upstream from Ennis was electrofished in 1979. Fish species captured were brook and brown trout, longnose sucker and mottled sculpin. The electrofishing survey data are summarized in Table 2-129.

Table 2-129. Summary of electrofishing survey data collected for a 550 ft section of Moore Creek (T6S, R1W, Sec. 4) on May 16, 1979.

Species	Number Captured	Length Range (inches)	Mean Length (inches)
Brook trout	9	4.7 - 10.8	7.4
Brown trout	5	8.8 - 15.4	11.3
Longnose sucker	3	5.5 - 7.3	6.5
Mottled sculpin	5	-	-

The low density arctic grayling population that inhabits Ennis Reservoir and the channels of the Madison River below the town of Ennis spawn in lower Moore Creek. This is the only remaining grayling population in the Madison basin outside of Yellowstone National Park. Lower Moore Creek is the only documented reproductive site for this population, although spawning may also occur in the mainstem Madison River as well. The possibility exists that a

stream-dwelling (fluvial) form of grayling may also inhabit lower Moore Creek year-round, although no such population has been documented to date.

WILDLIFE:

The Moore Creek drainage provides year-round habitat, including important winter range, for mule deer and elk. Antelope seasonally inhabit the lower drainage from spring through fall. Beaver, mink and bobcat are the primary resident furbearers. A few blue and sage grouse and Hungarian partridge are also present.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population; to protect important spawning habitat for the arctic grayling population inhabiting Ennis Reservoir and the channels of the Madison River below the town of Ennis; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.4 cfs (1,014 A.F./yr)

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Moore Creek. The instream flow request is, therefore, based on the fixed percentage method described earlier. Under this method, 47% of the average annual flow is being requested for those Madison River tributaries having high fishery values. An average annual flow of 3.0 cfs was estimated by the USGS for Moore Creek. An instream flow of 1.4 cfs is, therefore, requested.

STREAM NAME: North Meadow Creek

STREAM REACH: From the headwaters to the mouth - 16.8 miles

LOCATION: Sec. 11, T4S, R3W to Sec. 34, T4S, R1W

DESCRIPTION OF STREAM REACH:

North Meadow Creek originates on the east slope of the Tobacco Root Mountains in southwest Montana and flows 16.8 miles before joining South Meadow Creek to form Meadow Creek, which then flows a few hundred feet to Ennis Reservoir. Stream elevations at the origin and mouth are about 8,400 and 4,840 ft, respectively. The stream gradient averages 212 ft/mile. North Meadow Creek drains an area of approximately 53 square miles.

The stream section from the mouth to about stream mile 7 is surrounded by private agricultural lands. Commodities produced are wheat, hay and forage. The upper 10 miles of stream are surrounded by coniferous forest interspersed with sagebrush-grass meadows. Numerous beaver ponds are contained within this section. The drainage is served by 13.5 miles of road of which 3 miles lie on public lands.

Non-recreational activities in the North Meadow Creek drainage are associated with mining, which began in the late 1800's, and agriculture. There are about six small mines in operation today. The precious metals and low grade ores of copper, tungsten, iron and molybdenum that occur within the drainage may precipitate increased mining activity in the future. Grazing also occurs on public lands within the drainage. Recreational activities include hunting, snowmobiling, picnicking, camping, hiking and fishing.

Flow information is limited for North Meadow Creek. The approximate mean flow, derived for a USFS gage site near stream mile 13.8 for the period of April-November 1965-79, was 36 cfs. Flows during this period ranged from 3 to 240 cfs. In 1966, 10.1 miles of North Meadow Creek were critically affected by dewatering during the summer irrigation season (Wipperman, 1967).

GAME FISH PRESENT: Brown trout, mountain whitefish, rainbow trout, brook trout, cutthroat trout.

FISHERY:

A 1,000 ft section of lower North Meadow Creek near its mouth was electrofished on August 6 and 20, 1980. Game fish captured in descending order of abundance were brown trout, mountain whitefish, rainbow trout and brook trout. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-130.

Table 2-130. Summary of electrofishing survey data collected for a 1,000 ft section of North Meadow Creek (T4S, R1W, Sec. 34) on August 6 and 20, 1980.

Fish Species	Number Captured	Length Range (inches)
Brown trout	276	2.8 - 20.6
Mountain whitefish	4	3.5 - 4.6
Rainbow trout	3	3.3 - 10.0
Brook trout	1	5.5
Mottled sculpin	-	-

The standing crop of brown trout, the predominant game species in the section, was estimated using a mark-recapture method (Table 2-131). The estimate shows that this 1,000 ft section supported about 398 brown trout (4.0 inches and longer), weighing 124 pounds. Populations of mountain whitefish and rainbow and brook trout were too sparse to estimate using mark-recapture procedures. Of the mountain tributaries electrofished in the Madison drainage, lower North Meadow Creek supported one of the highest standing crops of trout.

Table 2-131. Estimated standing crop of brown trout in a 1,000 ft section of lower North Meadow Creek (T4S, R1W, Sec. 34) on August 6, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	4.0 - 5.9	73	
	6.0 - 9.9	232	
	10.0 - 20.6	93	
		398(±53)	124(±18)

In 1980, a population estimate was also conducted on a 1,000 ft section of upper North Meadow Creek. One hundred fifty-six brook trout from 3.4-9.9 inches and one 6.9 inch cutthroat trout were captured. This upper section supported an estimated 349 brook trout (4.0 inches and longer), weighing 24 pounds (Table 2-132).

Table 2-132. Estimated standing crop of brook trout in a 1,000 ft section of upper North Meadow Creek (T3S, R2W, Sec. 32C) on July 21, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.0 - 5.9	298	
	6.0 - 9.9	<u>51</u>	
		349(±114)	24(±7)

North Meadow Creek is also believed to provide spawning and nursery habitats for the low density brown and rainbow trout populations of Ennis Reservoir. In addition, the creek may provide a cold water refuge when elevated summer water temperatures stress the trout in Ennis Reservoir, forcing them to seek cooler water.

WILDLIFE:

Mule deer and elk are the principal big game species inhabiting the North Meadow Creek drainage from spring through fall. A few of these animals also winter within the area. Other common big game species are moose, which are present year-round, and black bear. Antelope occasionally summer in the lower drainage along with a few white-tailed deer. Mountain goats inhabit the steep slopes in the headwaters. A few mountain lion are also present. Furbearers include otter, beaver, mink, marten and a few bobcat. Blue grouse, Hungarian partridge and an occasional ruffed grouse are the resident upland game birds within the basin.

WETTED PERIMETER:

Cross-sectional measurements were made in a 156 ft riffle-run sequence located near the mouth (T4S, R1W, Sec. 34). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 17.9, 28.4 and 68.1 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-118. Lower and upper inflection points occur at approximate flows of 9 and 18 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning and nursery habitats for migrant trout from Ennis Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 18 cfs (13,031 A.F./yr)

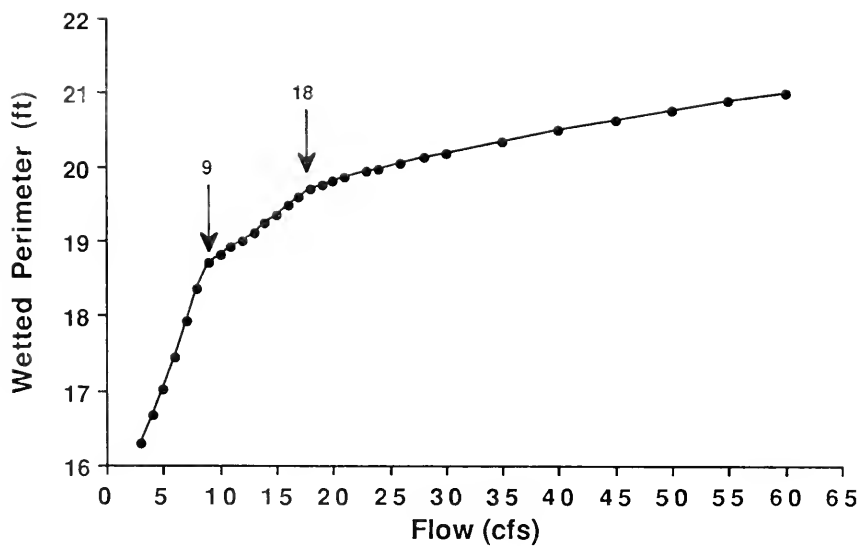


Figure 2-118. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in North Meadow Creek.

STREAM NAME: Hot Springs Creek

STREAM REACH: From the confluence of the North and Middle Forks to the mouth
- 12.5 miles

LOCATION: Sec. 23, T3S, R2W to Sec. 10, T3S, R1E

DESCRIPTION OF STREAM REACH:

Hot Springs Creek originates at the confluence of its North and Middle Forks in the foothills of the Tobacco Root Mountains of southwest Montana and flows 12.5 miles through private and state leased lands before discharging into the Madison River. Above the town of Norris, much of the creek passes through open, sagebrush covered hills. Grasses, forbs and some brush comprise the vegetation along the creek. Below Norris, the creek flows through a narrow canyon to its confluence with the Madison River. Much of the lower creek has been rechanneled to accommodate Highway 287. Here, the riparian zone is primarily vegetated with willows, water birch and other brushy species. The creek has a gravel-sand substrate covered in many places with a layer of silt. The width of the lower creek at low flow averages 11 ft.

Major land use activities in the drainage are livestock grazing and hay production. Some mining has occurred in the past.

The mean annual water yield of the Hot Springs Creek drainage was estimated by the SCS (1976) at 6,400 acre-feet (8.8 cfs). Wipperman (1967) identified 9.5 miles of Hot Springs Creek as being critically dewatered during the summer irrigation season.

GAME FISH PRESENT: Rainbow trout, brown trout, brook trout.

FISHERY:

A 1,000 ft section of Hot Springs Creek was electrofished on July 10, 17 and 28, 1980. Game fish captured in descending order of abundance were rainbow, brown and brook trout. Non-game species captured were white, longnose and mountain sucker, longnose dace and mottled sculpin. The electrofishing survey data are summarized in Table 2-133.

Table 2-133. Summary of electrofishing survey data collected for a 1,000 ft section of Hot Springs Creek (T3S, R1E, Sec. 9 and 10) on July 10, 17 and 28, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	48	4.4 - 11.7
Brown trout	26	5.8 - 15.0
Brook trout	9	6.7 - 8.9
Longnose sucker	9	5.6 - 7.4

Table 2-133. (Continued)

Fish Species	Number Captured	Length Range (inches)
Mountain sucker	2	5.6 - 6.0
White sucker	1	7.2
Longnose dace	1	4.2
Mottled sculpin	-	-

The standing crops of brown and rainbow trout were estimated using a mark-recapture method (Table 2-134). The estimate showed that this 1,000 ft section supported about 130 trout, weighing 36 pounds. Rainbow trout, the predominant trout species, accounted for about 72% of the total numbers and 56% of the biomass. Nine brook trout captured in the section are not included in the estimate.

Table 2-134. Estimated standing crop of trout in a 1,000 ft section of Hot Springs Creek (T3S, R1E, Sec. 9 and 10) on July 17, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	5.0 - 5.9	24	
	6.0 - 9.9	44	
	10.0 - 11.7	<u>26</u>	
		94(±37)	20(±8)
Brown trout	5.5 - 5.9	3	
	6.0 - 9.9	17	
	10.0 - 15.0	<u>16</u>	
		36(±11)	16(±5)
Total trout		130(±39)	36(±9)

Sections of Hot Springs Creek, encompassing 3,460 ft of the lower stream, were electrofished on October 24 and 28 and November 6, 1985 to assess the use of Hot Springs Creek as a reproductive site by adult brown trout from the Madison River. This stretch contained many beaver dams, some of which may have hindered brown trout movement. One hundred twenty-six brown trout 11 inches and longer were captured. Most were presumed to be

migrant spawners from the Madison River. Of these fish, 103 (from 11.0-21.4 inches in length) received numbered floy tags. In 1986, anglers reported catching three of these tagged fish in the Madison River and one in Warm Springs Creek. Three additional tagged fish were recaptured in April of 1986 during the Department's annual electrofishing work on the Norris Section of the Madison River.

A redd count was conducted on a 1,000 ft portion of this stretch on November 6, 1985. Seventeen brown trout redds were observed, most of which were located near the streambank.

The 1,000 ft section of Hot Springs Creek that was electrofished in July, 1980 and found to support a resident population of about 11 brown trout 11.0 inches and longer yielded a total of 54 brown trout within this size group during the 1986 spawning survey. It is apparent that this increase in the number of larger brown trout is due to an influx of spawners from the Madison River. Hot Springs Creek is undoubtedly an important spawning tributary for the Madison River brown trout population and likely contributes significant numbers of young to the river sport fishery. Use of Hot Springs Creek in spring by rainbow trout spawners from the Madison River is also believed to be significant; however, the magnitude of this run has not been evaluated in electrofishing studies.

WILDLIFE:

The mule deer is the most common game animal within the Hot Springs Creek drainage. Elk winter in the upper drainage and white-tailed deer are found along the lower stream. Pronghorn antelope are also seasonal residents of the drainage. Use of Hot Springs Creek by waterfowl is limited.

WETTED PERIMETER:

Cross-sectional measurements were made in a 75 ft section of lower Hot Springs Creek at about stream mile 0.3. Six cross-sections were established in a riffle-pool sequence. The WETP program was calibrated to field data collected at flows of 9.5, 20.2 and 31.9 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-119. Lower and upper inflection points occur at approximate flows of 2.0 and 5.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning and nursery habitats for trout residing in the Madison River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5.5 cfs (3,982 A.F./yr)

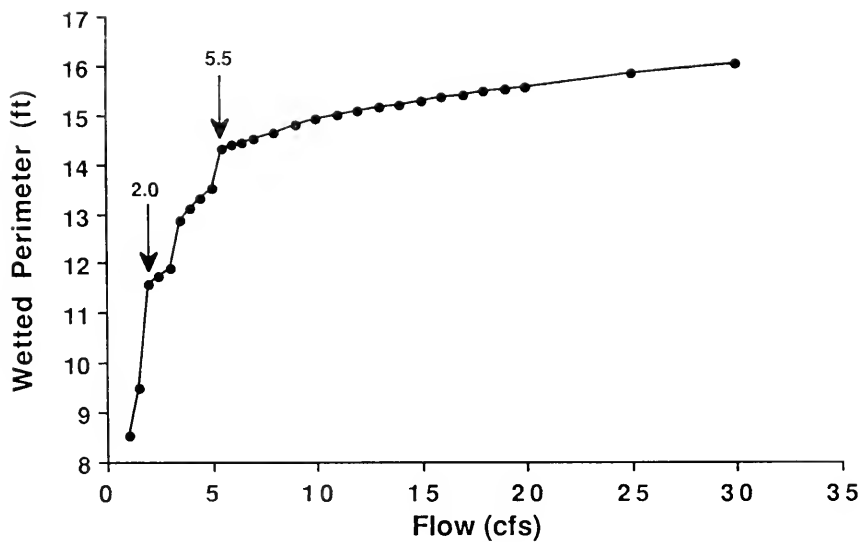


Figure 2-119. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Hot Springs Creek.

STREAM NAME: Cherry Creek

STREAM REACH: From the headwaters to the mouth - 21 miles

LOCATION: Sec. 26, T4S, R1E to Sec. 36, T2S, R1E

DESCRIPTION OF STREAM REACH:

Cherry Creek originates in the Madison Mountain Range of southwest Montana and flows about 21 miles before joining the lower Madison River at river mile 26. Most of Cherry Creek, except for the uppermost 20% which flows through the Gallatin National Forest, is surrounded by privately owned lands used for hay and small grain production and grazing.

Banks adjacent to agricultural lands along lower Cherry Creek are vegetated with willows, brush and grasses. Here, the bottom substrate consists of gravel, sand and silt. The steeper, upper reaches pass through hillsides and mountains wooded with conifers and junipers. The mean annual flow of Cherry Creek was estimated by the SCS (1976) at 35.2 cfs. At low flow, Cherry Creek near its mouth averages about 28 ft in width.

The lower 4.5 miles of Cherry Creek can be severely dewatered during the summer irrigation season. Silting of the lower creek as a result of poor land use practices is also a problem.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout.

FISHERY:

Two adjacent 1,000 ft sections of Cherry Creek were electrofished in the fall of 1985, primarily to assess the use of Cherry Creek as a reproductive site by brown trout spawners from the Madison River. The lowermost section (Section I), which was electrofished on November 7, extended upstream from the Highway 84 bridge near the stream's mouth. Game fish present in descending order of abundance were rainbow trout, brown trout and mountain whitefish. Table 2-135 summarizes the electrofishing catch data for a single pass through the section.

Table 2-135. Electrofishing survey data collected for a 1,000 ft section (Section I) of Cherry Creek (T2S, R1E, Sec. 36AC) on November 7, 1985.

Species	Number Captured	Length Range (inches)	Ave. Length (inches)
Rainbow trout	109	2.9 - 14.6	9.5
Brown trout	95	3.5 - 19.1	9.5
Mountain whitefish	Observed	12.0+	-
White sucker	3	5.9 - 13.5	8.6

Section II, which began at the head of Section I, was electrofished on October 30 and November 7, 1985. Game fish captured in descending order of abundance were brown trout, rainbow trout, mountain whitefish and brook trout. A summary of the electrofishing catch data for the two passes through this section is given in Table 2-136.

Table 2-136. Summary of electrofishing survey data collected for a 1,000 ft section (Section II) of Cherry Creek (T2S, R1E, Sec. 36BD) on October 30 and November 7, 1985.

Species	Number Captured	Length Range (inches)	Ave. Length (inches)
Brown trout	164	3.3 - 19.0	11.6
Rainbow trout	128	3.7 - 12.7	8.5
Mountain whitefish	26	4.7 - 17.5	-
Brook trout	1	6.4	-
Mottled sculpin	Present	-	-

During the survey, 24 redds were counted in Section I and 37 redds in Section II. Large whitefish were present in both sections and may have constructed some of the observed redds. Most of the female spawners captured in the sections appeared spent, indicating that the peak of the spawning run was missed.

Numbered floy tags were attached to 98 of the larger brown trout captured in Sections I and II. These fish, which ranged from 12.0-19.1 inches in length, were presumed to be migrant spawners from the Madison River. In 1986, anglers reported catching five of these tagged brown trout in the Madison River as far upstream as Beartrap Canyon. Another tagged fish was recaptured in April, 1986 during the Department's annual electrofishing work on the Norris Section of the Madison River. Based on the electrofishing and tag return information collected to date, Cherry Creek appears to provide significant spawning habitat for brown trout from the Madison River and, thus, may also be an important contributor of young recruits to the river sport fishery. Use of Cherry Creek in spring by rainbow trout spawners from the Madison River is also believed to be substantial, although electrofishing surveys have not been conducted to date to document such use.

The magnitude of the year-round, resident trout population of Cherry Creek was not enumerated during the electrofishing surveys. However, the survey data suggest, particularly for rainbow trout, that a substantial resident population is present.

WILDLIFE:

Big game species occupying the Cherry Creek drainage include elk, moose, mule deer, white-tailed deer and black bear. The drainage is particularly

noted for abundant populations of elk, which summer throughout much of the drainage and winter in the lower basin, and black bear. Mink, muskrat and beaver are associated with the creek bottom lands. Other important wildlife species found in the drainage are marten, bobcat, lynx and wolverine. Game birds in the area include ring-necked pheasant, Hungarian partridge, ruffed grouse and blue grouse. Some waterfowl use occurs during the spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a 25-ft section of Cherry Creek near its confluence with the Madison River. Three riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 28.2, 36.1 and 91.2 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-120. Lower and upper inflection points occur at approximate flows of 10 and 15 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide spawning and rearing habitats for trout and whitefish residing in the Madison River; to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 15 cfs (10,859 A.F./yr)

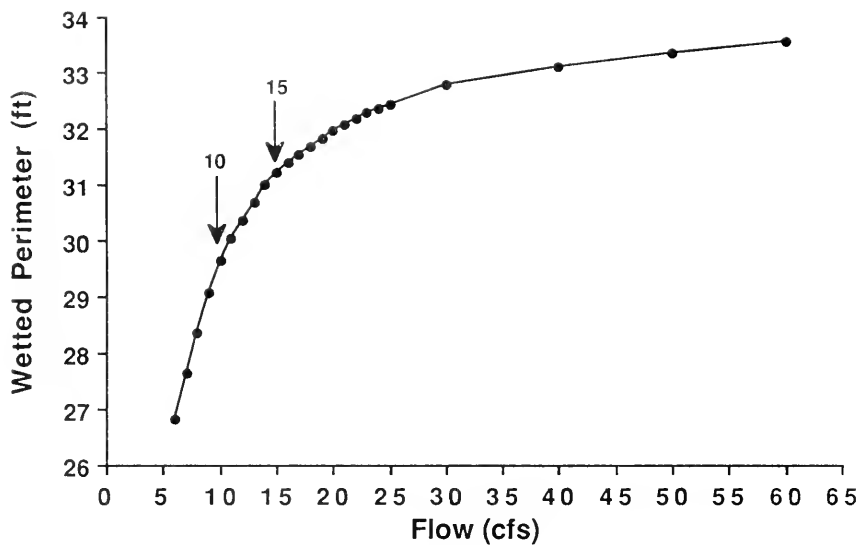


Figure 2-120. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Cherry Creek.

GALLATIN RIVER SUB-BASIN

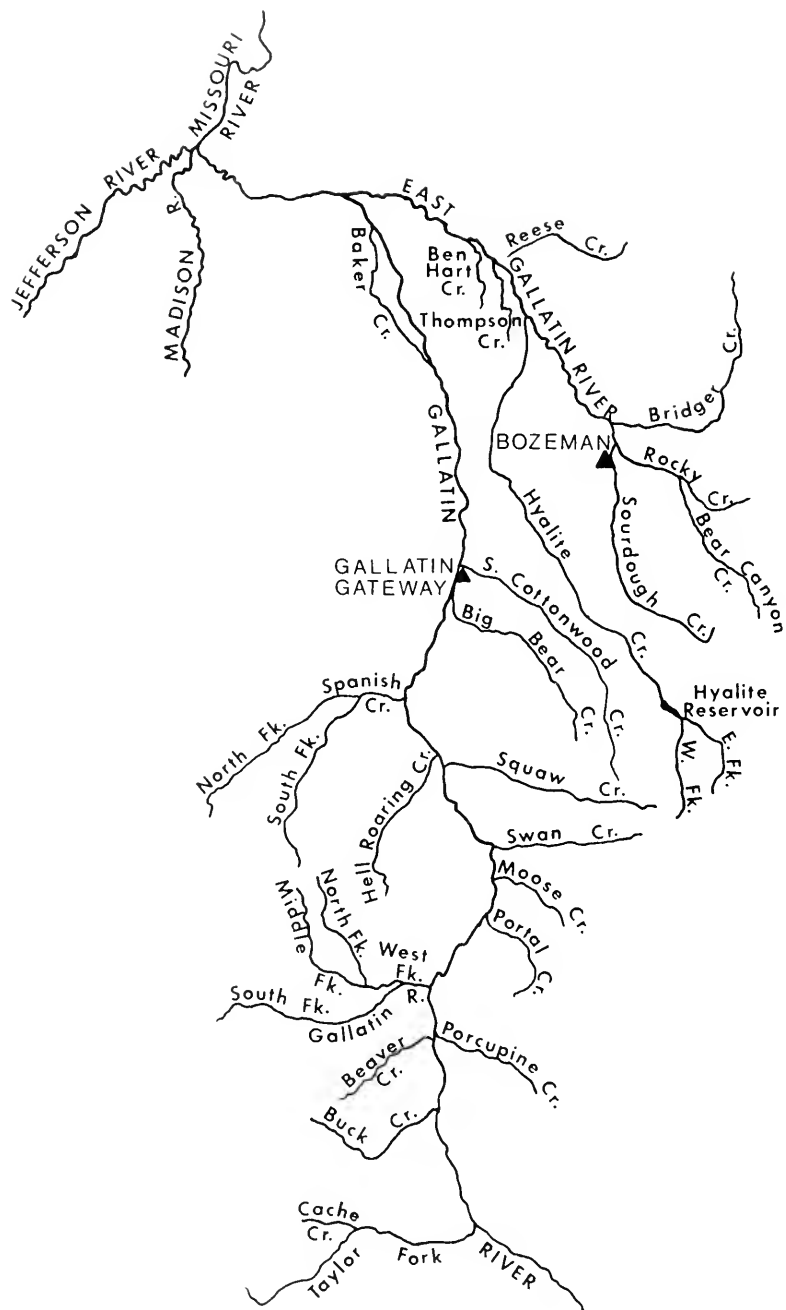


Figure 2-121. Map of the Gallatin River Sub-Basin.

STREAM NAME: Gallatin River

DESCRIPTION OF BASIN:

The free-flowing Gallatin River originates at Gallatin Lake in Yellowstone National Park at an elevation of 8,834 ft. It flows north for 115 miles to Three Forks, Montana, where it joins the Madison and Jefferson Rivers to form the Missouri River. From the Park boundary, the river flows about 44 miles through the narrow Gallatin Canyon, then enters the broad Gallatin Valley where it flows an additional 45 miles to its mouth. Much of the Gallatin River is classified "Blue Ribbon" by the MDFWP in recognition of its high recreational, fishery and aesthetic values.

The Gallatin River drains an area of 11,000 square miles, all above an elevation of 4,000 ft. Most of the drainage basin above 5,000 ft is covered with coniferous forest, while the basin below 5,000 ft consists primarily of the Gallatin Valley, one of the richest agricultural regions in Montana.

Much of the upper 70 miles of the Gallatin River are surrounded by public lands within Yellowstone National Park and the Gallatin National Forest. This section, except for the uppermost 12 miles, is closely paralleled by US 191, which provides easy access to the river. Dude ranches, lodges and Forest Service campgrounds are scattered throughout the area. The Big Sky of Montana complex, a large recreational development constructed in the 1970's, exemplifies the growth occurring in the canyon area. The steady rise in recreational and homesite development and tourism is expected to have considerable impact on the canyon area in future years.

The lower 45 miles of river flow primarily through private lands within the Gallatin Valley. Access to the lower river is readily obtained through some private lands, state fishing access sites and at bridge crossings. Bozeman, which is 7 miles from the river at the closest point of contact, is the largest population center in the drainage.

The Gallatin River is heavily utilized by both resident and nonresident anglers. The Montana Department of Fish, Wildlife and Parks estimated the total fishing pressure between May, 1983 and April, 1984 at 56,397 man-days (MDFWP, 1984). A survey conducted in the summer of 1978 for a section of river near the Karst Ranch (about river mile 62) estimated fishing pressure at 1,190 man-hours/mile or approximately 476 man-days/mile (Vincent, 1979). About 51 percent of this pressure was generated by nonresident anglers. In 1978, fishermen caught 0.81 trout per hour and creeled 417 trout per mile of river. Of the 9 major rivers in the Upper Missouri drainage of southwest Montana, the Gallatin ranks second behind the Madison River in total fishing pressure.

Many factors contribute to the popularity of the Gallatin River with fishermen and other recreationists. Much of the river is surrounded by public lands, making it readily accessible to recreationists. The river is also near a rapidly growing population center and is paralleled by a main route to Yellowstone National Park. Above all, the natural beauty of the river and surrounding mountains attracts recreationists.

The relatively small size of the river, the many channel obstructions and easy bank access are primarily responsible for the limited use of the Gallatin River by float fishermen. However, whitewater kayaking and rafting are popular during spring runoff in the Gallatin Canyon.

STREAM NAME: Gallatin River

STREAM REACH: #1. From the Yellowstone National Park boundary to the confluence of the West Fork Gallatin River - 18.9 miles

LOCATION: Sec. 18, T9S, R5E to Sec. 32, T6S, R4E

DESCRIPTION OF STREAM REACH:

Much of Reach #1 flows through Forest Service lands used primarily for recreation, logging and wildlife. The river in this reach passes through the upper Gallatin Canyon and is characterized by a preponderance of wide, shallow, fast flowing riffle areas. At low flow, mean stream width averages 104 ft. The river in Reach #1 has a boulder-cobble-gravel bottom. Throughout much of the reach, conifers extend to the stream banks. Dense willow cover is prevalent along the lower portion of the reach. No irrigation diversions are present.

Farnes and Shafer (1972) estimated the mean annual water yield for the Gallatin River above its West Fork at 328,500 acre-feet (454 cfs).

GAME FISH PRESENT: Rainbow trout, mountain whitefish, brown trout, cutthroat trout.

FISHERY:

The upper Gallatin River within Reach #1 produces an abundance of pan-size rainbow trout in the 7-10 inch class, with few exceeding 14 inches. Brown trout to 18 inches are also present along with an occasional cutthroat trout. Other common species include mountain whitefish and mottled sculpin.

A population estimate in October, 1984 showed that a mile of the upper river (at about river mile 73) supported about 1,661 age II and older rainbow and brown trout, weighing a total of 536 pounds. Rainbow trout comprised 95% of the trout numbers and 79% of the biomass.

WILDLIFE:

The upper Gallatin River drainage is particularly noted for its high density elk population. Other big game species present are mule deer, black bear, moose and mountain lion. The upper drainage is within designated grizzly bear range. Resident furbearers include mink, beaver, muskrat, coyote, marten and bobcat. Limited waterfowl use occurs during the spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of the upper Gallatin River at the Gallatin Wildlife Management Area approximately 3 miles upstream from the confluence of the West Fork. Two riffle cross-sections were established. The WETP computer program was calibrated to field data collected at flows of 236, 342 and 462 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross sections is shown in Figure 2-122. An upper inflection point occurs at an approximate flow of 170 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 170 cfs (123,074 A.F./yr)

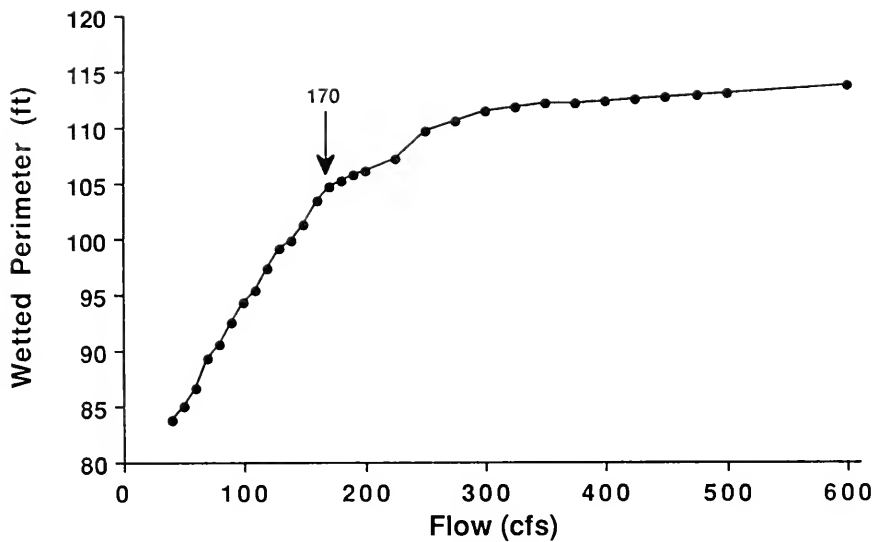


Figure 2-122. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #1 of the Gallatin River.

STREAM NAME: Gallatin River

STREAM REACH: #2. From the confluence of the West Fork Gallatin River to the confluence of the East Gallatin River - 57.5 miles

LOCATION: Sec. 32, T6S, R4E to Sec. 27, T2N, R3E

DESCRIPTION OF STREAM REACH:

The upper 25 miles of Reach #2 flow through the Gallatin Canyon, while the lower 33 miles are within the Gallatin Valley. As the river leaves the canyon, flow is progressively depleted during the summer irrigation season. At the lower end of Reach #2, sections of river commonly go dry during low water years.

Since the 1890's, the USGS has operated a gage at river mile 47.7 of the Gallatin River about 3 miles upstream from the mouth of the Gallatin Canyon. Above this site, water to irrigate about 1,400 acres of land is diverted. The mean annual flow for a 52-year period of record was 815 cfs. Mean monthly flows ranged from 307 cfs (for February) to 3,000 cfs (for June).

A USGS gage at river mile 43.6 was operated for 13 years between 1895 and 1923. The mean annual flow was 959 cfs and mean monthly flows ranged from 351 cfs (in March) to 3,730 cfs (in June).

GAME FISH PRESENT: Mountain whitefish, rainbow trout, brown trout, brook trout, cutthroat trout.

FISHERY:

As with all rivers, the MDFWP manages the Gallatin River as a wild trout fishery. In the canyon section of Reach #2, the rainbow trout is the dominant trout species, while the brown trout is dominant in the valley. Rainbow trout from 10-14 inches and brown trout in the 12-17 inch class are the mainstay of the fishery. Brown trout as large as 8.0 pounds have been captured during the department's electrofishing efforts. In recent years, fishermen have caught brown trout as large as 11 pounds. An occasional rainbow trout in the 4-5 pound class is caught each year, but few exceed 19 inches. Other game fish present are cutthroat trout, rainbow x cutthroat hybrids, brook trout, and mountain whitefish. Non-game fish include mottled sculpin, longnose sucker, white sucker, mountain sucker and longnose dace.

The MDFWP has throughout past years estimated the game fish populations in various sections of Reach #2 using electrofishing techniques. An estimate made in September, 1978 for a section within the Gallatin Canyon showed that a mile of river supported approximately 2,115 adult rainbow and brown trout, weighing about 1,082 pounds (Vincent, 1979). An upper valley section near Gallatin Gateway in September, 1977 supported an estimated 1,233 adult brown and rainbow trout, weighing 1,042 pounds, per river mile (Vincent and Nelson, 1978). As the river progresses through the valley and more water is diverted for irrigation, trout populations decline markedly.

Reach #2 of the Gallatin River also supports a substantial population of mountain whitefish. In September, 1977 an upper valley section near Gallatin

Gateway supported approximately 955 adult whitefish, weighing 901 pounds, per river mile (Vincent and Nelson, 1978).

WILDLIFE:

The bottomlands along the valley portion of Reach #2 support huntable populations of mule deer, white-tailed deer and upland game birds, including ring-necked pheasant, Hungarian partridge and ruffed grouse. Furbearers include mink, beaver, muskrat, otter, raccoon, red fox and coyote. Bald eagles commonly winter within the river corridor. A great blue heron rookery is located along the river near Belgrade.

The mountainsides adjacent to the canyon section support huntable populations of elk, mule deer, moose, bighorn sheep, mountain goat, black bear and mountain lion. Resident game birds are blue grouse and ruffed grouse. Furbearers include mink, beaver, badger, muskrat, marten, bobcat, lynx, otter, wolverine, red fox and coyote. A portion of the canyon area is within designated grizzly bear range. Both golden and bald eagles are commonly observed within the canyon.

Ducks and geese use the Gallatin River during spring and fall migrations. The valley section provides some nesting habitat for Canada geese. Other nesting waterfowl include blue-winged teal, mallard and common merganser. Goldeneyes and mergansers commonly winter on the river.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 400 cfs (289,587 A.F./yr)

A study completed in 1978 evaluated the impacts of summer irrigation withdrawals (dewatering) on trout populations within Reach #2 of the Gallatin River (Vincent and Nelson, 1978). The study results strongly suggested that the magnitude of the flows during the summer irrigation season is the primary factor limiting the numbers and pounds (standing crops) of adult trout in the valley portion of the river. The relationship between the magnitude of the summer flows and trout standing crops, as derived from this study, is illustrated in Figure 2-123. This relationship shows that the study section having the highest summer flows supported the highest trout population. Based on this relationship, the MDFWP has determined that a summer flow of 400 cfs would be adequate for maintaining the high quality recreational fishery of the Gallatin River at the existing level. A summer flow of 400 cfs would support approximately 235 adult trout, weighing 200 pounds, per 1,000 feet of river. A recommendation of 400 cfs, while not the most desired flow as shown in Figure 2-123, is a reasonable request when considering the high recreational values and resulting economic benefits derived from the existing high quality trout fishery of the river.

This 400 cfs recommendation is applied to the entire year even though it was derived from data pertaining to only a portion of this period (the summer irrigation season).

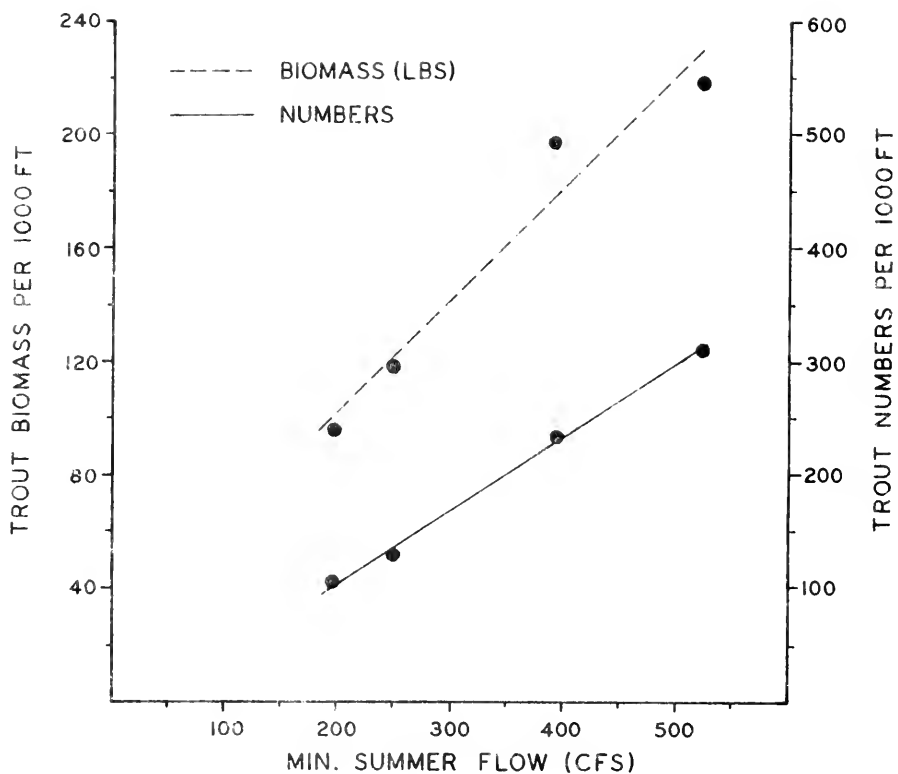


Figure 2-123. Relationship between the minimum summer flow (cfs) and the estimated numbers and biomass (lbs) of adult trout in sections of the West Gallatin River in September, 1976 and 1977 (adapted from Vincent and Nelson, 1978).

STREAM NAME: Gallatin River

STREAM REACH: #3. From the confluence of the East Gallatin River to the mouth - 12.4 miles.

LOCATION: Sec. 27, T2N, R3E to Sec. 9, T2N, R2E

DESCRIPTION OF STREAM REACH:

Reach #3 passes through cottonwood bottoms and steep cliffs that are surrounded by agricultural and grazing lands. The river has a boulder-rubble-gravel substrate that is heavily silted in the slower flowing areas. Banks are heavily vegetated with brush and large cottonwoods. Riprap is common along vast stretches of river paralleling the railroad bed. Debris piles, log jams and long, deep pools provide much of the fish cover. Tributaries are limited to a few spring creeks.

Water quality in Reach #3 is presently considered good. The river is slightly turbid year-round due to the sediment input from the East Gallatin River. The East Gallatin River and a few small tributaries draining agricultural land produce excessive sediment loads at times. Sediment accumulations drastically reduce the survival of trout eggs, reduce the numbers and kinds of trout food organisms, and fill in trout habitat.

Public access to this 12.4-mile section of river is provided at the Missouri Headwaters State Park near Three Forks and at the Gallatin Forks Fishing Access Site near Manhattan, both of which are operated by the MDFWP. Access is also obtained through some private lands and at bridge and railroad crossings.

Floating is a popular recreational activity during the fishing season and fall waterfowl season. Numerous outfitters float the river, providing their clients with single-day fishing trips.

The mean annual flow of Reach #3 at the USGS gage at river mile 6.3 was 1,057 cfs for a 63-year period of record. Mean monthly flows ranged from 473 cfs (for August) to 2,970 cfs (for June). Base winter flow was 684 cfs. About 110,000 acres are irrigated above this gage site. As a result, Reach #3 is severely dewatered during the summer irrigation season. The fact that August is typically the lowest flow month of the year demonstrates the severity of present flow depletions.

GAME FISH PRESENT: Mountain whitefish, brown trout, rainbow trout, brook trout.

FISHERY:

Game fish present in Reach #3 in descending order of abundance are mountain whitefish, brown trout, rainbow trout and brook trout. Non-game species include white sucker, longnose sucker, mottled sculpin and longnose dace.

Reach #3, which is classified "Blue Ribbon" by the MDFWP, provides a good sport fishery for 1-2 pound trout in spring, early summer and fall.

Anglers annually catch brown trout in the 5-10 pound class, while trout as large as 7 pounds have been captured during the department's electrofishing surveys. Extremely large brown trout in excess of 15 pounds have been observed while electrofishing, but have avoided capture.

A trout population estimate completed in Spring, 1980 showed that a mile of river supported about 686 and 523 age one and older (about 5 inches and longer) brown and rainbow trout, respectively, weighing a total of 587 pounds (Rehwinkel and Vincent, 1982). The severe dewatering that plagues the lower Gallatin in most summers is likely responsible for the lower than expected standing crops within this reach. Given greater summer flows, this reach is capable of supporting higher trout numbers.

WILDLIFE:

The bottomland along Reach #3 supports huntable populations of mule deer, white-tailed deer, ring-necked pheasant, Hungarian partridge and ruffed grouse. Furbearers within the river bottom include beaver, muskrat, mink, otter, raccoon, red fox and coyote. A great blue heron and cormorant rookery is located along the river near Logan.

Ducks and geese use the river during spring and fall migrations. Canada geese commonly nest on islands within Reach #3, with about 15-20 breeding pairs utilizing this river section annually. Other nesting waterfowl include blue-winged teal, mallard and common merganser. Goldeneyes and mergansers commonly winter on the river.

WETTED PERIMETER:

The wetted perimeter inflection point method was applied to a riffle/run area of Reach #3 in T2N, R2E, Sec. 35A. The WETP program was calibrated to field data collected at flows of 414, 539 and 1,250 cfs.

The relationship between wetted perimeter and flow for a composite of two riffle/run cross-sections is shown in Figure 2-124. Lower and upper inflection points occur at approximate flows of 500 and 1,000 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1,000 cfs (723,967 A.F./yr)

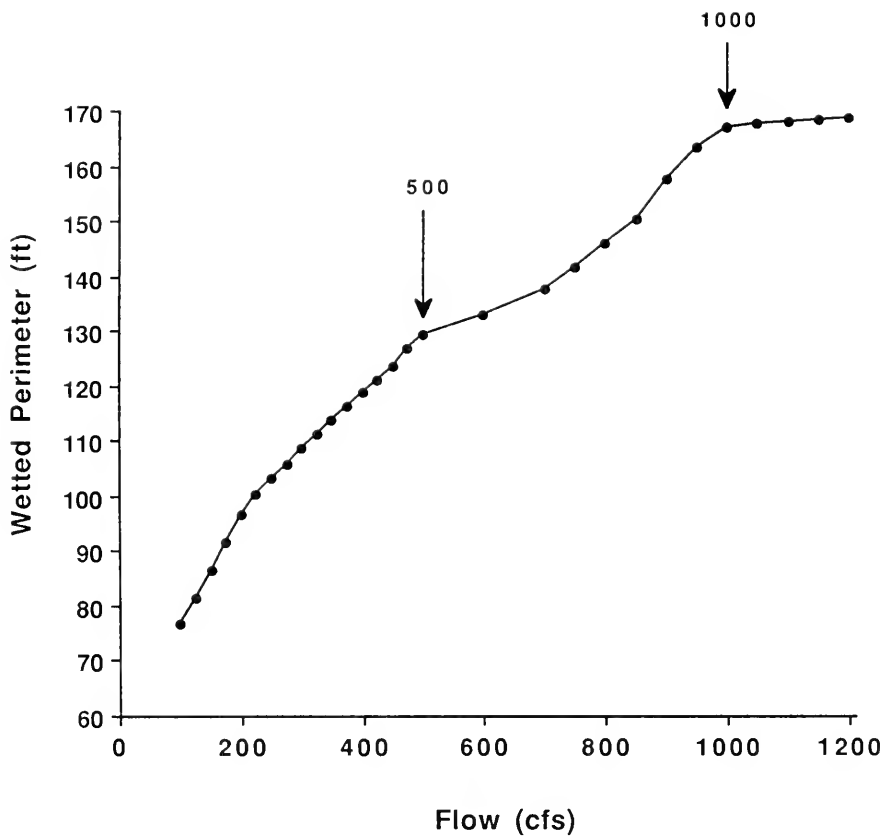


Figure 2-124. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #3 of the Gallatin River.

STREAM NAME: Cache Creek

STREAM REACH: From the headwaters to the mouth - 3.7 miles

LOCATION: Sec. 31, T8S, R3E to Sec. 10, T9S, R3E

DESCRIPTION OF STREAM REACH:

Cache Creek originates in the Taylor-Hilgard Range of southwest Montana and flows 3.7 miles to its confluence with the Taylor Fork, a tributary to the Gallatin River. Lands within the basin are in a checker-board ownership between the Gallatin National Forest and Burlington Northern Railroad. The upper stream passes through steep, conifer-covered hillsides and mountains, while the lower stream meanders through an open sagebrush flat before joining the Taylor Fork.

Lower Cache Creek has a cobble, gravel and silt bottom and, at low flow, averages about 9.3 ft in width. The mean annual flow, as estimated by Steve Glasser, Hydrologist with the Gallatin National Forest, is 8.4 cfs.

Land use activities include grazing, logging and recreation. Burlington Northern lands within the drainage have been extensively logged within the past 15 years. Silt depositions in the channel are likely a direct result of recent logging.

GAME FISH PRESENT: Cutthroat trout, rainbow x cutthroat hybrid trout, rainbow trout.

FISHERY:

A 1,000 ft section of Cache Creek was electrofished on August 22 and September 4, 1975. Cutthroat and rainbow trout were the only game fish species captured.

The standing crop of cutthroat trout, the predominant trout species in the section, was estimated using a mark-recapture method (Table 2-137). The estimate shows that this 1,000 ft section supported about 109 cutthroat trout (4.0 inches and longer), weighing 14 pounds.

Cache Creek is one of relatively few Gallatin River tributaries that still supports a game fish population consisting almost entirely of cutthroat trout. The native cutthroat populations of the vast majority of Gallatin tributaries have been replaced by brook, brown and rainbow trout, species introduced to the drainage. The cutthroat trout of Cache Creek are probably not pure westslope cutthroat - the only trout species native to the upper Missouri River drainage of Montana. Introduced Yellowstone cutthroat trout and rainbow trout, species that readily hybridize with the native cutthroat, have likely contaminated the gene pool, obliterating the native cutthroat stock.

Table 2-137. Estimated standing crop of trout in a 1,000 ft section of Cache Creek (T9S, R3E, Sec. 4) on August 22, 1975. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Cutthroat trout	4.0 - 5.9	51	
	6.0 - 9.9	56	
	10.0 - 11.9	2	
		109(±48)	14(±6)

WILDLIFE:

The Cache Creek drainage is particularly noted for its abundant, year-round moose population and a high density summer elk population. Mule deer, black bear, marten, wolverine, bobcat and mink are other important wildlife species found in the basin. The Cache Creek drainage is within designated grizzly bear range. Cache Creek provides little, if any, habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in an approximate 500-ft section of Cache Creek located near the stream's mouth (T9S, R3E, Sec. 10BB). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 1.8, 4.4 and 8.0 cfs.

The relationship between wetted perimeter and flow for a composite of five riffle cross-sections is shown in Figure 2-125. Lower and upper inflection points occur at approximate flows of 1.2 and 2.6 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.6 cfs (1,882 A.F./yr)

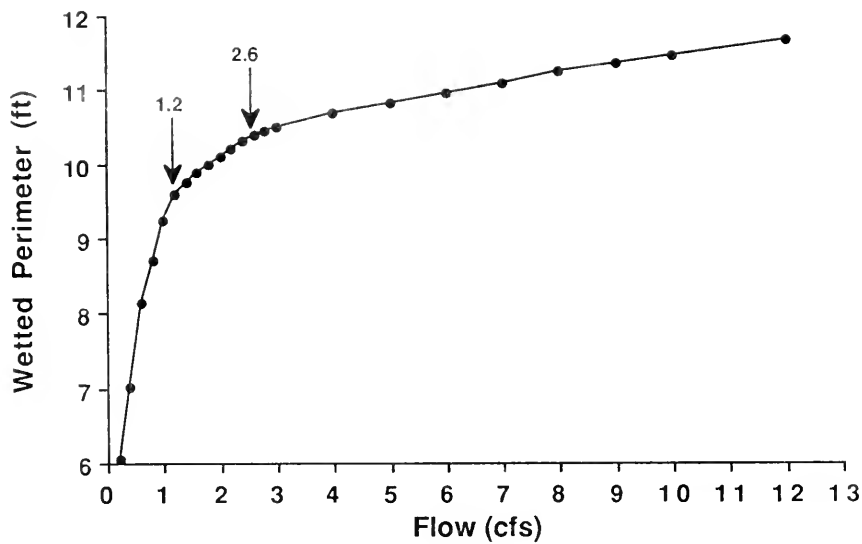


Figure 2-125. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Cache Creek.

STREAM NAME: Taylor Fork of the Gallatin River

STREAM REACH: From the confluence of Tumbledown Creek to the mouth - 13.7 miles

LOCATION: Sec. 19, T9S, R3E to Sec. 2, T9S, R4E

DESCRIPTION OF STREAM REACH:

The Taylor Fork of the Gallatin River originates on the east slope of the Taylor Peaks in southwest Montana and flows in an easterly direction for about 17 miles before discharging into the Gallatin River. The stream elevations at the origin and mouth are about 9,200 and 6,600 ft, respectively. Stream gradient averages about 153 ft/mile. The mean channel width of the lower Taylor Fork at low flow is 64 ft. The Taylor Fork drains an area of approximately 107 square miles.

The Taylor Fork drainage encompasses sagebrush-grasslands, forested slopes and steep, treeless ridges. The streambanks are considered unstable due to their geological composition (Snyder et al., 1968). Consequently, portions of the Taylor Fork and its tributaries experience severe bank erosion. A large portion of the sediment load of the Taylor Fork is contributed by the Cement Creek drainage.

Land uses in the Taylor Fork drainage include livestock grazing, logging and mining. Gold mining occurred intermittently from about 1880 to 1945 (State Engineer's Office, 1953). Timber harvesting (primarily for railroad ties) was extensive from about 1898 to 1906. Since 1906 small scale logging has occurred on National Forest lands. The clear cutting of private lands within the drainage has been extensive. Livestock grazing has continued since 1890.

Recreational activities in the Taylor Fork drainage include hunting, hiking, backpacking, camping, horseback riding, cross-country skiing, snowmobiling and fishing. A portion of the Big Sky Snowmobile Trail traverses the southern part of the drainage.

The USGS intermittently operated a gage at stream mile 0.5 of the Taylor Fork from 1946-67. The mean annual flow for the 10-year period of record was 97.9 cfs. Mean monthly flows ranged from 17 cfs (for February and March) to 432 cfs (in June).

GAME FISH PRESENT: Rainbow trout, mountain whitefish, cutthroat trout, brown trout.

FISHERY:

A 1,000 ft section of the Taylor Fork was electrofished on October 17 and 24, 1980. Game fish captured in descending order of abundance were rainbow trout, mountain whitefish, cutthroat trout and brown trout. The mottled sculpin was the only non-game species collected. The electrofishing survey data are summarized in Table 2-138.

Table 2-138. Summary of electrofishing survey data collected for a 1,000 ft section of the Taylor Fork of the Gallatin River (T9S, R4E, Sec. 2C) on October 17 and 24, 1980.

Fish Species	Number Captured	Length Range (inches)
Wild rainbow trout	84	5.0 - 11.3
Mountain whitefish	19	6.2 - 11.2
Cutthroat trout	8	6.7 - 12.0
Brown trout	7	9.5 - 11.4
Mottled sculpin	1	-

The standing crop of rainbow trout, the predominant trout species, was estimated using a mark-recapture method (Table 2-139). The estimate shows that this 1,000 ft section supported about 131 rainbow trout, weighing 41 pounds. Populations of mountain whitefish and brown and cutthroat trout were too sparse to estimate using the mark-recapture method.

Table 2-139. Estimated standing crop of rainbow trout in a 1,000 ft section of the Taylor Fork of the Gallatin River (T9S, R4E, Sec. 2C) on October 17, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Wild rainbow trout	5.0 - 6.9	a)	
	7.0 - 9.9	100	
	10.0 - 11.3	<u>31</u>	
		131(±44)	41(±14)

a) An estimate for this length group is unavailable due to insufficient recaptures.

Since 1954, catchable-size rainbow trout have been planted in the Taylor Fork (T9S, R4E, Sec. 2). In recent years, the plant has been reduced to about 1,000 catchables per year.

WILDLIFE:

The Taylor Fork drainage supports populations of elk, mule deer, moose, mountain goat, bighorn sheep, black bear and cougar. Grizzly bears have

been observed in the area. The drainage lies within a major migration route for elk using the summer range in Yellowstone National Park and the winter range along the west slope of the Madison Range. Upland game birds include ruffed and blue grouse. Furbearers and other small mammals common to southwest Montana are also present.

WETTED PERIMETER:

Cross-sectional measurements were made in a 580-ft section of the Taylor Fork located at about stream mile 2 (Sec. 9D, T9S, R4E). Four riffle cross-sections were established in this section; however, one cross-section was subsequently discarded due to calibration problems. The WETP program was calibrated to field data collected at flows of 47.2, 101.6 and 256.0 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-126. Lower and upper inflection points occur at approximate flows of 16 and 36 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 36 cfs (26,063 A.F./yr)

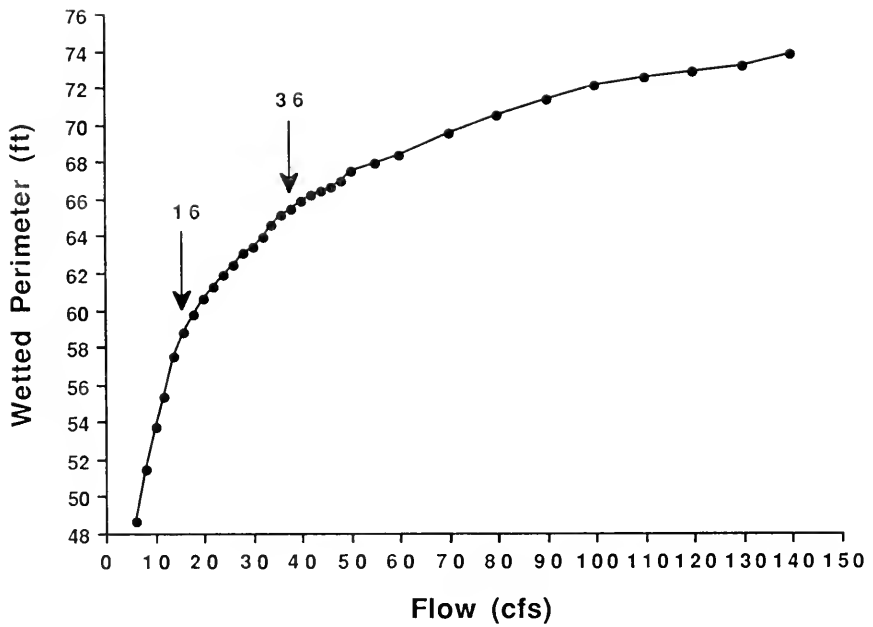


Figure 2-126. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in the Taylor Fork of the Gallatin River.

STREAM NAME: Porcupine Creek

STREAM REACH: From the confluence of the North Fork of Porcupine Creek to the mouth - 4.7 miles

LOCATION: Sec. 30, T7S, R5E to Sec. 16, T7S, R4E

DESCRIPTION OF STREAM REACH:

Porcupine Creek originates on the west slope of the Gallatin Range of southwest Montana and flows in a northwesterly direction for about 8.5 miles before discharging into the Gallatin River at river mile 73. Stream elevations at the origin and mouth are approximately 8,800 and 6,240 ft, respectively. The stream gradient averages about 300 ft/mile. Mean width of the lower creek at low flow is about 20 ft. Ownership of lands within the drainage is shared by the Montana Dept. of Fish, Wildlife and Parks (Gallatin Wildlife Mgmt. Area), U.S. Forest Service and Burlington Northern Railroad.

Porcupine Creek is currently served by approximately 15.5 miles of road, but only 0.5 mile is open to motor vehicle travel year-round. Travel on the remaining 15 miles is regulated by the U.S. Forest Service. Developed foot and horse trails provide most of the access into the drainage. A portion of the Big Sky snowmobile trail traverses the upper drainage.

Timber harvesting within the drainage last occurred in 1950 and all grazing leases were terminated in the early 1950's. The drainage is primarily managed as a winter game range by the MDFWP and USFS.

Recreational activities within the drainage include fishing, snowmobiling, hiking, backpacking, horseback riding, cross-country skiing, trail biking and hunting. Hunting exceeds all other recreational uses. The resident and migratory elk populations attract hunters from early fall to mid-winter depending upon permitted late season hunts. Other big game species are also hunted. Six commercial outfitter camps are permitted by special use permit during the big game season.

The mean annual flow of Porcupine Creek was estimated by Farnes and Shafer (1972), Steve Glasser (hydrologist with the Gallatin National Forest) and the USFS (1973) at 24.3, 25.3 and 30.5 cfs, respectively.

GAME FISH PRESENT: Rainbow trout, brown trout, cutthroat trout, mountain whitefish.

FISHERY:

A 1,000 ft section of lower Porcupine Creek was electrofished on August 13 and September 4, 1980. Sixty-four rainbow trout from 3.2-7.9 inches were captured. The mottled sculpin was the only other species present.

The standing crop of rainbow trout was estimated using a mark-recapture method (Table 2-140). The estimate shows that this 1,000 ft section supported about 108 rainbow trout (3.2 inches and longer), weighing 6 pounds.

Table 2-140. Estimated standing crop of trout in a 1,000 ft section of Porcupine Creek (T7S, R4E, Sec. 16B) on August 13, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.2 - 5.9	91	
	6.0 - 7.9	17	
		108(±30)	6(±2)

A 1,000 ft section of Porcupine Creek was electrofished by the MDFWP in 1975 (Vincent, 1976). Game fish captured in descending order of abundance were rainbow trout (40 captured), brown trout (2 captured), cutthroat trout (2 captured) and mountain whitefish (2 captured).

WILDLIFE:

Elk are the predominant big game species within the Porcupine drainage. The drainage provides critical winter range for both resident and migratory elk populations. Other big game species include mule deer, moose, bighorn sheep, black bear, cougar and possibly grizzly bear. Upland game birds are ruffed and blue grouse. Furbearers such as mink, marten, weasel, coyote, bobcat, lynx, wolverine, skunk and badger are also present. Small mammals and birds common to southwest Montana are also found within the drainage.

WETTED PERIMETER:

Cross-sectional measurements were made in a 470-ft section of Porcupine Creek near its mouth (Sec. 16BC, T7S, R4E). Four riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 7.1, 13.2 and 32.8 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-127. Lower and upper inflection points occur at flows of about 3 and 6 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

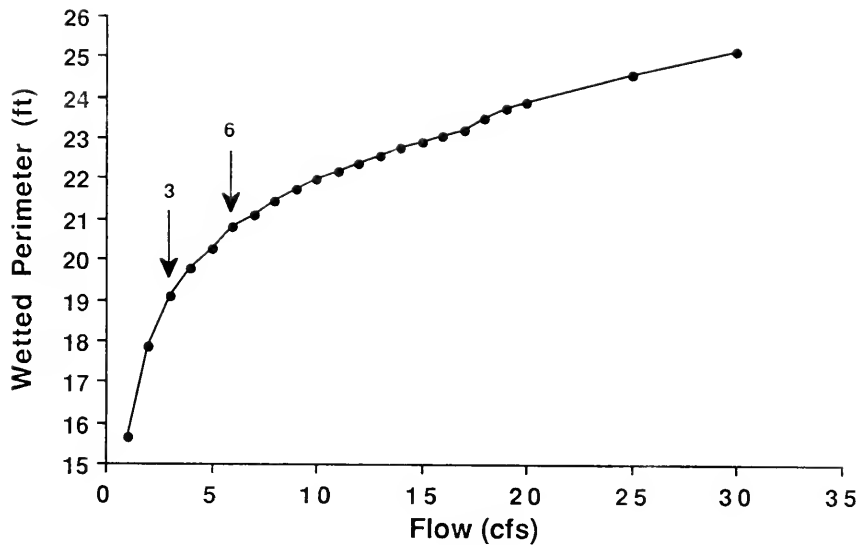


Figure 2-127. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Porcupine Creek.

FLOW REQUEST: January 1-December 31 -- 4.5 cfs (3,258 A.F./yr)

Of the 18 Gallatin Canyon tributaries electrofished by Vincent (1976) in 1975, only five were judged as having "substantial" fisheries. Porcupine Creek was among this group. Although Porcupine Creek supports a trout standing crop of only 6 pounds per 1,000 ft, this population is significant relative to most of the other tributaries within the Gallatin Canyon. A flow mid-way between the lower and upper inflection points (4.5 cfs) is, therefore, requested.

STREAM NAME: Middle Fork of the West Fork Gallatin River

STREAM REACH: From the headwaters to the junction with the North Fork of the West Fork Gallatin River - 5.9 miles

LOCATION: Sec. 24, T6S, R2E to Sec. 35, T6S, R3E

DESCRIPTION OF STREAM REACH:

The Middle Fork originates on the slopes of Lone Mountain and flows about 5.9 miles through private lands within the Big Sky resort complex before joining the North Fork of the West Fork to form the West Fork of the Gallatin River. Numerous homesite and resort developments occur on hillsides and flats surrounding some portions of the creek.

The creek has a boulder-cobble-gravel substrate and a mean width of 21 ft for its lower reaches at low flow. Stream banks are vegetated with conifers in most areas. Steve Glasser, hydrologist with the Gallatin National Forest, estimated the mean annual flow of the Middle Fork at 14.2 cfs.

GAME FISH PRESENT: Rainbow trout, brook trout.

FISHERY:

A 1,000 ft section of the lower Middle Fork was electrofished on August 15 and 29, 1979. Thirty-three rainbow trout, ranging from 3.1-16.0 inches, and 12 brook trout from 3.7-7.7 inches were captured. No other species were present.

The standing crop of rainbow trout, the predominant species in the section, was estimated using a mark-recapture method (Table 2-141). This section supported about 47 rainbow trout (3.1 inches and longer), weighing 7 pounds. When compared to other mountain streams of similar size in the Gallatin Canyon, the trout population of the Middle Fork is only fair.

Table 2-141. Estimated standing crop of rainbow trout in a 1,000 ft section of the Middle Fork of the West Fork Gallatin River (T6S, R3E, Sec. 35) on August 15, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.1 - 5.9	22	
	6.0 - 9.9	23	
	10.0 - 16.0	<u>2</u>	
		47(±13)	7(±1)

WILDLIFE:

The Middle Fork drainage provides prime summer range for elk as well as year-round range for moose. Furbearers present include beaver, mink, bobcat and marten. Use of the Middle Fork by waterfowl is limited.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of the Middle Fork near its confluence with the North Fork. Two riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 16.6, 32.1 and 63.0 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-128. A prominent upper inflection point occurs at an approximate flow of 6.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 3.0 cfs (2,172 A.F./yr)

An instream flow request less than the upper inflection point flow is warranted for the Middle Fork because the stream supported a standing crop of trout that was judged only fair for a mountain stream of its size within the Gallatin Canyon. Because a lower inflection point was not readily discernible on the wetted perimeter-flow relationship, a flow of $\frac{1}{2}$ (3.0 cfs) the upper inflection point flow is, therefore, recommended.

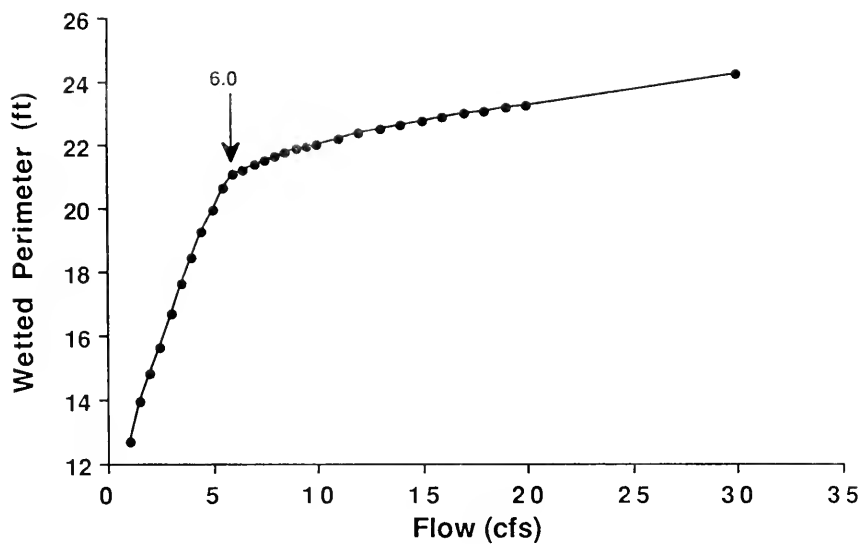


Figure 2-128. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the Middle Fork of the West Fork Gallatin River.

STREAM NAME: South Fork of the West Fork Gallatin River

STREAM REACH: From the headwaters to the mouth - 13.2 miles

LOCATION: Sec. 9, T7S, R2E to Sec. 31, T6S, R4E

DESCRIPTION OF STREAM REACH:

The South Fork of the West Fork Gallatin River originates in the Madison Range of southwest Montana and flows about 13.2 miles to its confluence with the West Fork Gallatin River. The stream drains an area of about 47 square miles. Elevations at its origin and mouth are 9,000 and 6,400 ft, respectively. Much of the stream passes through private timber lands owned by the Burlington Northern Railroad. The lower drainage has been logged extensively, resulting in high sediment loads within the stream system.

The South Fork has a boulder-cobble-gravel substrate that is heavily silted. Mean width of the lower South Fork at low flow is about 25 ft. Steve Glasser, hydrologist with the Gallatin National Forest, estimated the mean annual flow of the South Fork at 49.3 cfs.

GAME FISH PRESENT: Rainbow trout, cutthroat trout.

FISHERY:

In the summer of 1975, 18 streams in the upper Gallatin River drainage were electrofished to assess their fishery potential (Vincent, 1976). During the survey, a 1,000 ft section of the South Fork yielded 6 rainbow trout and 6 cutthroat trout. Only 5 of the 18 streams were found to have substantial fisheries. The South Fork was not among this group.

WILDLIFE:

The South Fork drainage is noted for providing prime summer range for elk and year-round habitat for moose. Furbearers within the drainage include beaver, mink, bobcat and marten. Waterfowl use of the South Fork is limited.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of the lower South Fork near its mouth. Two riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 19.1, 38.4 and 77.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-129. Lower and upper inflection points occur at approximate flows of 5 and 12 cfs, respectively.

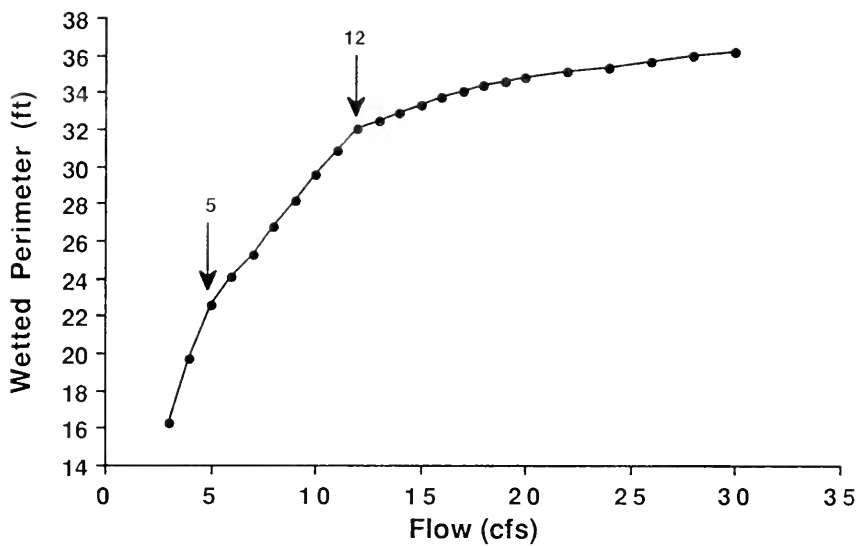


Figure 2-129. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the South Fork of the West Fork Gallatin River.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

STREAM NAME: West Fork of the Gallatin River

STREAM REACH: From the confluence of the Middle and North Forks to the mouth
- 4.2 miles

LOCATION: Sec. 35, T6S, R3E to Sec. 32, T6S, R4E

DESCRIPTION OF STREAM REACH:

The West Fork of the Gallatin River originates at the confluence of its Middle and North Forks and flows in an easterly direction for 4.2 miles before discharging into the Gallatin River. The stream elevations at the origin and mouth are about 6,400 and 5,880 ft, respectively. The stream gradient averages about 124 ft/mile. The West Fork drains an area of about 78 square miles. Mean width of the lower West Fork at low flow is 39 ft.

Much of the land in the West Fork drainage is a part of the Big Sky resort complex. The complex contains condominiums, a golf course and shopping and eating establishments. Several smaller private holdings have been developed for home sites. Prior to the construction of the Big Sky complex in the mid-1970s, the area was primarily used to graze cattle and sheep. Sightseeing, skiing and fishing are the primary recreational activities in the West Fork drainage.

The West Fork carries a high sediment load during spring runoff. The primary source of the sediment is a tributary where extensive logging has occurred (Snyder et al, 1978).

Farnes and Shafer (1972) and Steve Glasser (hydrologist, Gallatin N.F.) estimated the mean annual flow of the West Fork at 68.9 and 79.3 cfs, respectively.

GAME FISH PRESENT: Rainbow trout, mountain whitefish, brown trout, cutthroat trout.

FISHERY:

A 1,000 ft section of the West Fork of the Gallatin River was electrofished in 1975 (Vincent, 1976). Game fish captured in descending order of abundance were rainbow trout, mountain whitefish, brown trout, cutthroat trout and hatchery rainbow trout. The mottled sculpin was the only non-game species captured. The electrofishing survey data are summarized in Table 2-142.

Table 2-142. Summary of electrofishing survey data collected for a 1,000 ft section of the West Fork of the Gallatin River (T6S, R4E, Sec. 32C) on August 20 and September 4, 1975.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	75	3.3 - 12.4
Mountain whitefish	9	9.3 - 15.6
Brown trout	5	7.9 - 13.9
Cutthroat trout	4	3.2 - 8.7
Hatchery rainbow trout	3	9.0 - 9.7
Mottled sculpin	-	-

The standing crop of rainbow trout, the predominant trout species, was estimated using a mark-recapture method (Table 2-143). The estimate shows that this 1,000 ft section supported about 95 rainbow trout (4.0 inches and longer), weighing 18 pounds. Populations of mountain whitefish and brown, cutthroat and hatchery rainbow trout were too sparse to estimate using the mark-recapture method.

Table 2-143. Estimated standing crop of rainbow trout in a 1,000 ft section of the West Fork of the Gallatin River (T6S, R4E, Sec. 32C) on August 20, 1975. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Wild rainbow trout	4.0 - 5.9	27	
	6.0 - 9.9	58	
	10.0 - 12.4	10	
		95(±20)	18(±5)

The MDFWP planted catchable-size rainbow trout in the West Fork from 1956 to 1976. The number planted ranged from 200 to over 4,000 per year.

WILDLIFE:

The West Fork basin provides summer range for elk, mule deer and moose and limited winter range for moose and bighorn sheep. Mountain goats inhabit the steeper mountain slopes. Year-round furbearers within the drainage include marten, mink and bobcat. Resident upland game birds are ruffed and blue grouse. The West Fork provides little, if any, habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a 230-ft section of the West Fork at about stream mile 0.5 (Sec. 32CA, T6S, R4E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 27.8, 58.6 and 162.0 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-130. Lower and upper inflection points occur at approximate flows of 14 and 26 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 26 cfs (18,823 A.F./yr)

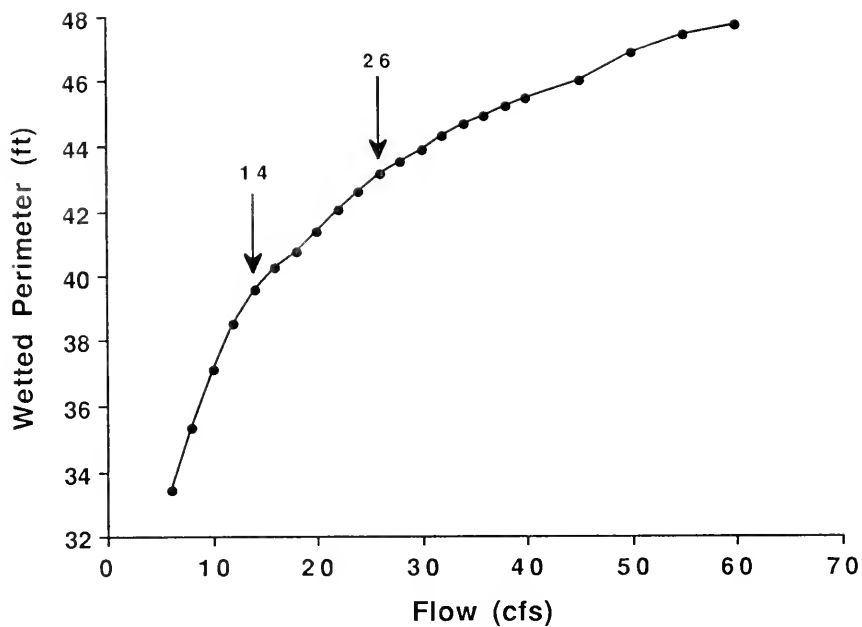


Figure 2-130. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in the West Fork Gallatin River.

STREAM NAME: Squaw Creek

STREAM REACH: From the headwaters to the mouth - 14.1 miles

LOCATION: Sec. 16, T5S, R6E to Sec. 33, T4S, R4E

DESCRIPTION OF STREAM REACH:

Squaw Creek originates on the west slope of the Gallatin Mountain Range of southwest Montana and flows in a westerly direction for 14.1 miles before discharging into the Gallatin River. Stream elevations at the origin and mouth are about 9,200 and 5,440 ft, respectively. Stream gradient averages about 267 ft/mile. Channel widths range from 10 to 30 ft and, for the lower stream, average 21.4 ft at low flow. Squaw Creek drains an area of approximately 55 square miles. Virtually all of the drainage is within lands controlled by the U.S. Forest Service and Burlington Northern Railroad.

Logging is the primary land use within the Squaw Creek drainage. From the 1880's through the early 1900's trees were mainly harvested for railroad ties. Until about 1950 only minor timber harvesting occurred. Since 1950 timber harvesting has been extensive. Approximately 18% of the drainage has been altered, primarily by logging and road building (Logan, 1973). This logging has occurred on both public and private lands. Livestock grazing has occurred within the Squaw Creek drainage since the 1930's. At present, the drainage is allotted about 115 head.

Recreational use of the Squaw Creek drainage is considered high. Approximately 40 miles of road serve the drainage, most of which is open to vehicle travel year-round. Recreational uses include hunting, trail bike riding, horseback riding, hiking, camping, cross-country skiing, backpacking, snowmobiling and fishing. The USFS maintains a campground on Squaw Creek, plus many miles of foot and horse trails.

The mean annual flow for Squaw Creek was estimated by Steve Glasser (hydrologist, Gallatin National Forest), Logan (1973) and Farnes and Shafer (1972) at 38.7, 41.3 and 48.5 cfs, respectively.

GAME FISH PRESENT: Rainbow trout, brown trout, brook trout.

FISHERY:

A 1,000 ft section of lower Squaw Creek was electrofished on August 12 and 25, 1980. Game fish captured in descending order of abundance were rainbow, brown and brook trout. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-144.

Table 2-144. Summary of electrofishing survey data collected for a 1,000 ft section of Squaw Creek (T4S, R4E, Sec. 35D) on August 12 and 25, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	134	3.1 - 12.3
Brown trout	8	4.7 - 11.4
Brook trout	4	5.2 - 8.4
Mottled sculpin	-	-

The standing crop of rainbow trout, the predominant trout species, was estimated using a mark-recapture method (Table 2-145). The estimate shows that this 1,000 ft section supported about 443 rainbow trout (3.1 inches and longer), weighing 45 pounds. Populations of brown and brook trout were too sparse to estimate using the mark-recapture method. For a mountain stream of its size, Squaw Creek supports a fairly substantial biomass of trout.

Table 2-145. Estimated standing crop of rainbow trout in a 1,000 ft section of Squaw Creek (T4S, R4E, Sec. 35D) on August 12, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.1 - 5.9	293	
	6.0 - 9.9	136	
	10.0 - 12.3	14	
		443(±167)	45(±12)

WILDLIFE:

Big game species found in the Squaw Creek drainage are elk, mule deer, moose, black bear, bighorn sheep, mountain goat and cougar. Upland game birds are ruffed and blue grouse. Furbearers such as mink, weasel, coyote and badger are present. Small mammals and birds common to southwestern Montana are also found.

WETTED PERIMETER:

Cross-sectional measurements were made in a 327-ft section of Squaw Creek near its mouth (Sec. 34CC, T4S, R4E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 23.5, 49.4 and 60.6 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-131. Lower and upper inflection points occur at approximate flows of 6 and 12 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 12 cfs (8,688 A.F./yr)

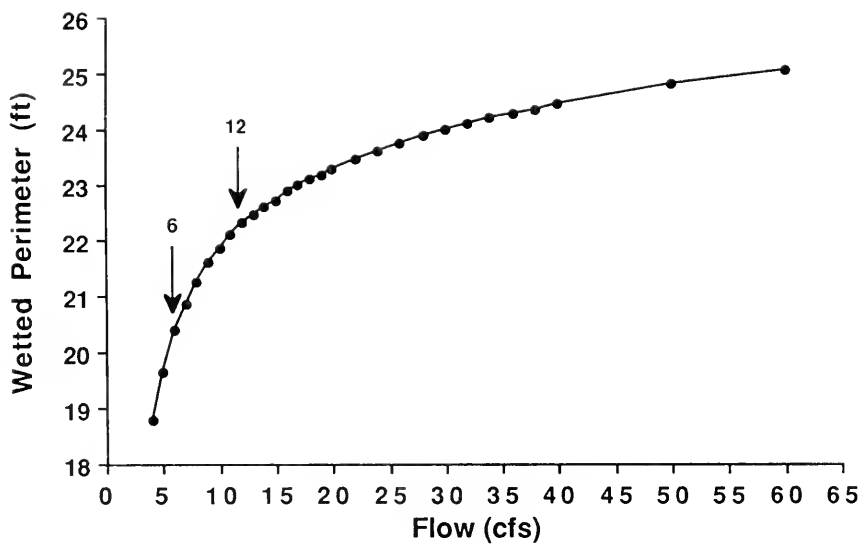


Figure 2-131. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Squaw Creek.

STREAM NAME: Hell Roaring Creek

STREAM REACH: From the confluence of the North Fork Hell Roaring Creek to the mouth - 5.0 miles

LOCATION: Sec. 13, T5S, R3E to Sec. 33, T4S, R4E

DESCRIPTION OF STREAM REACH:

Hell Roaring Creek originates in the Spanish Peaks of southwest Montana. The stream heads at an elevation of about 9,200 ft and flows in a northeasterly direction for about 11 miles before discharging into the Gallatin River at an approximate elevation of 5,350 ft. Stream gradient is high, averaging about 350 ft/mile.

The 30 square mile Hell Roaring Creek drainage lies almost entirely within the Lee Metcalf Wilderness Area. Access to the drainage and surrounding area is by a USFS trail heading along U.S. Highway 191. Backpacking, hiking, hunting, horseback riding and fishing are the primary activities within the drainage. Recreational use is considered high.

The SCS (Farnes and Shafer, 1972) estimated the average annual water yield of the Hell Roaring drainage at 32,600 acre-feet (45.0 cfs). The U. S. Forest Service (Steve Glasser, hydrologist, Gallatin National Forest) estimated the mean annual flow at 35.9 cfs. Water quality is considered excellent.

GAME FISH PRESENT: Rainbow trout.

FISHERY:

A 1,000 ft section of lower Hell Roaring Creek was electrofished on September 4 and October 8, 1980. Eighty-four rainbow trout from 3.2-13.6 inches were captured. The mottled sculpin was the only other species present.

The standing crop of rainbow trout was estimated using a mark-recapture method (Table 2-146). The estimate shows that this 1,000-ft section supported about 119 rainbow trout (4.0 inches and longer), weighing 18 pounds.

Table 2-146. Estimated standing crop of trout in a 1,000 ft section of Hell Roaring Creek (T4S, R4E, Sec. 33B) on September 4, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.0 - 5.9	55	
	6.0 - 9.9	56	
	10.0 - 13.6	8	
		119 (± 36)	18 (± 4)

Limited evidence suggests that rainbow trout from the Gallatin River use Hell Roaring Creek as a reproductive site. In 1978, an adult rainbow trout tagged in the Gallatin River about 19 miles downstream from the mouth of Hell Roaring Creek was caught by an angler 2-3 miles up Hell Roaring Creek in early June shortly after the spawning season. The presence of this fish in Hell Roaring Creek was assumed to be related to spawning.

WILDLIFE:

Wildlife found in the Hell Roaring Creek drainage include elk, mule deer, moose, bighorn sheep, mountain goat, black bear and cougar. Resident upland game birds are ruffed and blue grouse. Small mammals and birds common to southwest Montana are also present.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 16 cfs (11,583 A.F./yr)

The application of the wetted perimeter inflection point method to Hell Roaring Creek was inappropriate due to the steep, cascading nature of the stream. The requested instream flow is, therefore, based on the fixed percentage method described earlier. Under this method, 31% of the average annual flow is being requested for those Gallatin River tributaries having high fishery values. An average annual flow of 51.4 cfs was estimated by the USGS for Hell Roaring Creek. An instream flow of 16 cfs is, therefore, requested.

STREAM NAME: South Fork of Spanish Creek

STREAM REACH: From the confluence of Falls Creek to the mouth - 7.8 miles

LOCATION: Sec. 7, T5S, R3E to Sec. 11, T4S, R3E

DESCRIPTION OF STREAM REACH:

The South Fork of Spanish Creek originates in the Spanish Peaks of southwest Montana and flows in a northerly direction for about 13 miles before joining the North Fork to form Spanish Creek. The stream elevations at the origin and mouth are approximately 9,600 and 5,440 ft, respectively. The South Fork of Spanish Creek drains an area of about 40.5 square miles. Stream gradient averages about 320 ft/mile. Mean width of the lower South Fork at low flow is about 31 ft.

The upper 8.4 miles of the South Fork of Spanish Creek lie within the Gallatin National Forest and the Lee Metcalf Wilderness Area. The lower 4.6 miles flow through private lands used for livestock grazing, hay and small grain production and the propagation of wildlife. Access to the upper drainage is provided by 4.5 miles of USFS road. A USFS maintained campground is located at the end of this road. Several foot and horse trails provide access into the wilderness area and upper creek.

The primary land use is recreation. Recreational activities include hunting, backpacking, hiking, camping, horseback riding, fishing and sight-seeing. Recreational use of the upper drainage is high due to its wilderness designation.

Steve Glasser, hydrologist on the Gallatin National Forest, estimated the mean annual flow of the South Fork at 33.8 cfs.

GAME FISH PRESENT: Brook trout, rainbow trout, brown trout.

FISHERY:

Fish populations in a 1,000 ft section of the South Fork of Spanish Creek were surveyed by electrofishing on August 12 and 25, 1980. Game fish captured in descending order of abundance were brook, rainbow and brown trout. No other species were present. The electrofishing survey data are summarized in Table 2-147.

Table 2-147. Summary of electrofishing survey data collected for a 1,000 ft section of the South Fork of Spanish Creek (T4S, R3E, Sec. 32A) on August 12 and 25, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	104	3.2 - 9.4
Rainbow trout	10	3.9 - 9.7
Brown trout	2	7.9 - 11.7

The standing crop of brook trout, the predominant game species, was estimated using a mark-recapture method (Table 2-148). The estimate shows that this 1,000 ft section supports about 232 brook trout (3.2 inches and longer), weighing 18 pounds. The populations of rainbow and brown trout were too sparse to reliably estimate. The South Fork supports a fairly substantial trout population for a high elevation, mountain stream of its size.

Table 2-148. Estimated standing crop of brook trout in a 1,000 ft section of the South Fork of Spanish Creek (T4S, R3E, Sec. 32A) on August 12, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.2 - 5.9	167	
	6.0 - 9.4	65	
		232(±63)	18(±5)

WILDLIFE:

The South Fork drainage supports populations of moose, elk, mule deer, bighorn sheep, mountain goat and mountain lion. The drainage is a significant producer of furbearers, with marten, mink, beaver and bobcat the most important species. Game birds inhabiting the drainage are ruffed and blue grouse. The South Fork has little value for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a 446-ft section of the South Fork of Spanish Creek near stream mile 4.7 (Sec. 32A, T4S, R3E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 16.1, 65.0 and 124.9 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-132. Lower and upper inflection points occur at approximate flows of 8 and 15 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 15 cfs (10,859 A.F./yr)

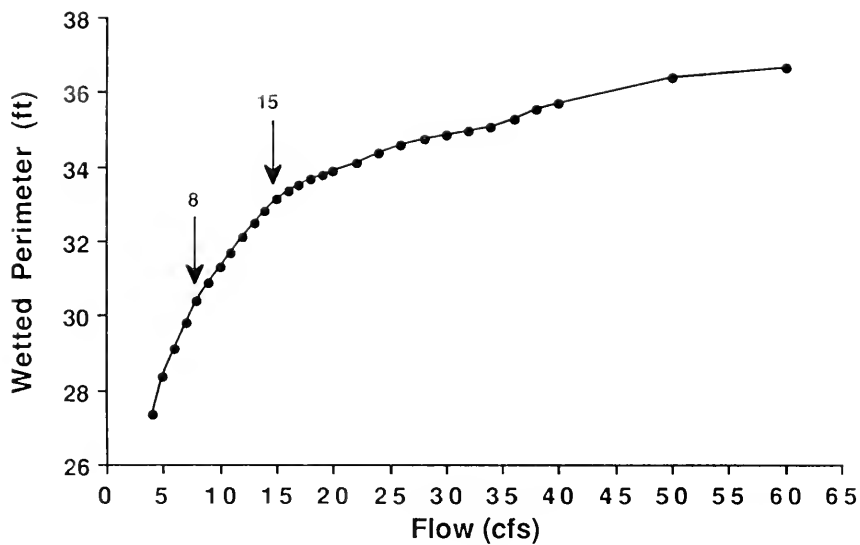


Figure 2-132. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in the South Fork of Spanish Creek.

STREAM NAME: Spanish Creek

STREAM REACH: From the confluence of its North and South Forks to the mouth
-3.0 miles

LOCATION: Sec. 11, T4S, R3E to Sec. 18, T4S, R4E

DESCRIPTION OF STREAM REACH:

Spanish Creek originates at the confluence of its North and South Forks at the base of the Spanish Peaks and flows 3.0 miles through a narrow valley before discharging into the Gallatin River. Lands surrounding Spanish Creek are privately owned and primarily used for livestock grazing. Some haying and logging also occurs. The creek drains an area of about 91 square miles.

Spanish Creek has a cobble-gravel bottom and an average width at low flow of 45 ft. The stream banks are thickly vegetated with grasses, willow and other woody plants.

The SCS (1976) estimated the mean annual water yield of the Spanish Creek drainage at 53,300 acre-feet (73.6 cfs). The 25-year peak flow was estimated at 1,160 cfs. Some water is diverted from Spanish Creek during the irrigation season. However, dewatering is minimal.

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout, mountain whitefish.

FISHERY:

A 1,000 ft section of Spanish Creek was electrofished on August 12 and 25, 1980. Game fish captured in descending order of abundance were rainbow trout, brook trout, brown trout and mountain whitefish. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-149.

Table 2-149. Summary of electrofishing survey data collected for a 1,000 ft section of Spanish Creek (T4S, R3E, Sec. 13) on August 12 and 25, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	276	3.4 - 14.5
Brook trout	40	4.6 - 12.8
Brown trout	7	5.4 - 15.5
Mountain whitefish	2	12.9 - 14.9

The standing crops of rainbow and brook trout were estimated using a mark-recapture method (Table 2-150). The estimate shows that this 1,000 ft

section supported over 541 trout, weighing 68 pounds. Rainbow trout, the predominant trout species, accounted for about 93% of the total trout numbers and 81% of the biomass. Standing crops of brown trout and mountain whitefish were too sparse to estimate using mark-recapture procedures. For a mountain stream of its size, Spanish Creek supports a substantial trout population.

Table 2-150. Estimated standing crops of trout in a 1,000 ft section of Spanish Creek (T4S, R3E, Sec. 13) on August 12, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.4 - 5.9	343	
	6.0 - 9.9	134	
	10.0 - 14.5	25	
		502(±77)	55(±8)
Brook trout	6.0 - 9.9	26	
	10.0 - 12.8	13	
		39(±11)	13(±3)
Total trout		541(±78)	68(±9)

WILDLIFE:

Lands surrounding Spanish Creek support resident and/or transient populations of elk, mule deer, white-tailed deer, black bear, moose and mountain lion. The drainage is particularly noted for its abundant elk and deer populations. Hunting is on a fee basis, with trophy-size bull elk the management objective of the private landowner. Common furbearers associated with the creek and surrounding lands are bobcat, beaver, mink, red fox and coyote. Waterfowl use is limited.

WETTED PERIMETER:

Seven cross-sections were established in a 395-ft section of Spanish Creek. The WETP program was calibrated to field data collected at flows of 55.5, 115.7 and 157.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-133. A prominent upper inflection point occurs at an approximate flow of 70 cfs.

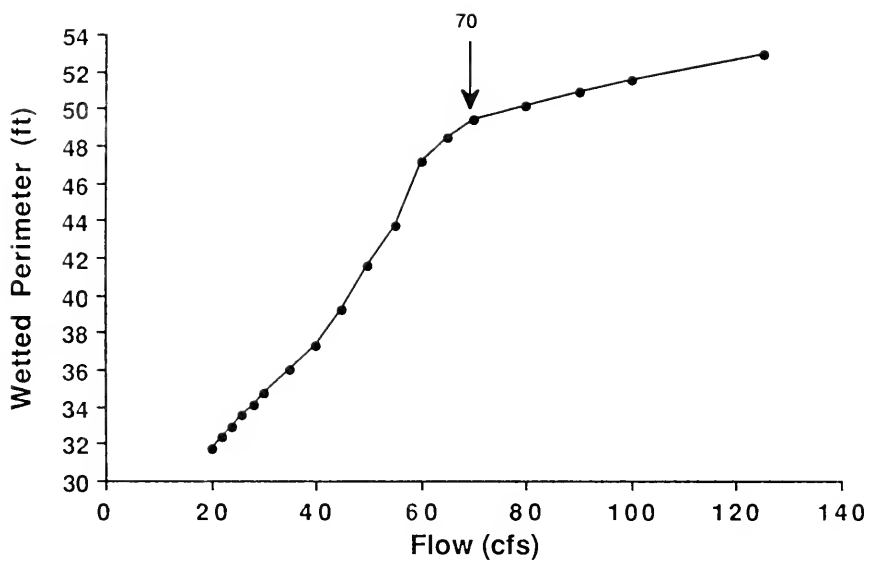


Figure 2-133. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Spanish Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 70 cfs (50,678 A.F./yr)

STREAM NAME: Big Bear Creek

STREAM REACH: From the headwaters to the mouth - 11.9 miles

LOCATION: Sec. 26, T4S, R5E to Sec. 22, T3S, R4E

DESCRIPTION OF STREAM REACH:

Big Bear Creek originates at the northern end of the Gallatin Mountain Range of southwest Montana and flows in a northwesterly direction for 11.9 miles before discharging into Wilson Creek, a tributary to the Gallatin River. Stream elevations at the origin and mouth are approximately 8,400 and 5,000 ft, respectively. Stream gradient averages about 286 ft/mile and channel widths range from about 3 to 18 ft. Big Bear Creek drains an area of approximately 13.2 square miles.

The section of Big Bear Creek from the mouth to near stream mile 5.0 is primarily surrounded by agricultural lands. The principal commodities produced are cattle and grains. Access to the stream is controlled by the surrounding private landowners.

The stretch from near stream mile 5.0 to the headwaters generally lies within steep, forested lands. Cattle grazing, small grain production and some timber harvesting occur. Approximately 7 miles of Big Bear Creek lie within the Gallatin National Forest. Access to the drainage is provided by a USFS regulated road that crosses 3 miles of private land.

Land uses in the lower Big Bear drainage include ranching and farming. Recreational activities, which include hunting, fishing, snowmobiling, cross-country skiing and firewood gathering, are mainly confined to the portion of the drainage within the National Forest.

The USGS operated a gage on Big Bear Creek at stream mile 4.7 from October, 1951 to December, 1953. The mean annual flow for the 1952-53 water years was 14.3 cfs. Mean monthly flows for the period of record ranged from 2.7 cfs (in March) to 69.2 cfs (in June).

GAME FISH PRESENT: Cutthroat trout, brook trout.

FISHERY:

Fish populations in a 1,000 ft section of Big Bear Creek (T4S, R5E, Sec. 4D) were surveyed by electrofishing on July 14, 1980. Cutthroat trout, brook trout and mottled sculpin were the only fish species captured. The electrofishing survey data are summarized in Table 2-151. The population of trout was too sparse to reliably estimate using the mark-recapture method.

Table 2-151. Summary of electrofishing survey data collected for a 1,000 ft section of Big Bear Creek (T4S, R5E, Sec. 4D) on July 14, 1980.

Fish Species	Number Captured	Length Range (inches)
Cutthroat Trout	3	4.6 - 6.8
Brook Trout	1	6.3
Mottled Sculpin	-	--

WILDLIFE:

The Big Bear Creek drainage supports populations of elk, mule deer, white-tailed deer, moose, black bear and cougar. Upland game birds in the upper drainage are ruffed and blue grouse, while ring-necked pheasant and Hungarian partridge are found in the lower drainage. Furbearers include weasel, bobcat, mink and coyote.

WETTED PERIMETER:

Cross-sectional measurements were made in a 47-ft riffle-pool sequence located near stream mile 7.6 (T4S, R5E, Sec. 4D). Five cross-sections were placed in this sequence. The WETP computer program was calibrated to field data collected at flows of 6.5, 27.1 and 39.1 cfs.

The relationship between wetted perimeter and flow for a composite of three riffle cross-sections is shown in Figure 2-134. Lower and upper inflection points occur at approximate flows of 2.0 and 3.5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.0 cfs (1,448 A.F./yr)

Because the fishery of Big Bear Creek is substantially lower than expected for a mountain stream of its size, the flow at the lower inflection point (2.0 cfs) is recommended from January 1-December 31.

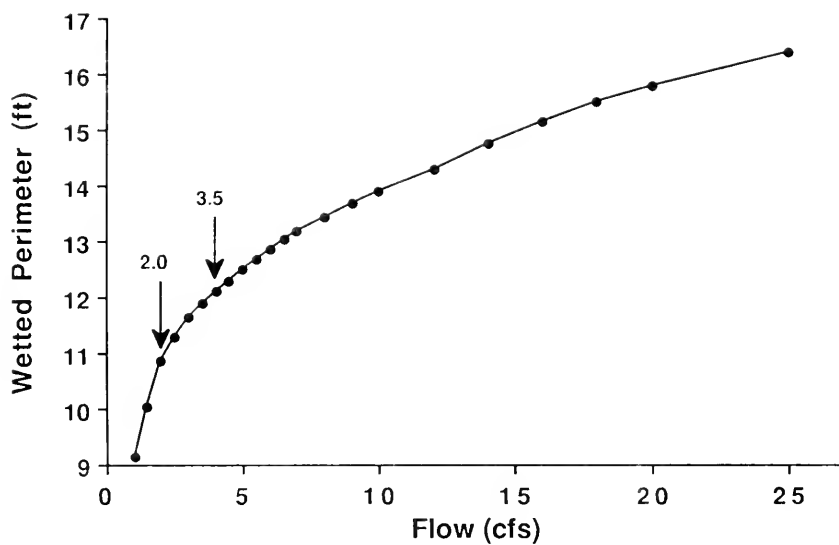


Figure 2-134. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Big Bear Creek.

STREAM NAME: South Cottonwood Creek

STREAM REACH: From the confluence of Jim Creek to the Hart Ditch headgate-
11.1 miles

LOCATION: Sec. 24, T4S, R5E to Sec. 12, T3S, R4E

DESCRIPTION OF STREAM REACH:

South Cottonwood Creek originates on the north slope of the Gallatin Range of southwest Montana and flows in a northwesterly direction for 17.6 miles before discharging into the Gallatin River. Stream elevations at the origin and mouth are about 8,600 and 4,880 ft, respectively. The stream gradient averages approximately 211 ft/mile. At low flow, the stream averages 26 ft in width. South Cottonwood Creek drains an area of about 42 square miles.

South Cottonwood Creek from the mouth to near stream mile 6.2 is primarily surrounded by agricultural lands. The principal commodities produced are cattle, grains and hay. Access is restricted and controlled by private landowners. Severe dewatering of this section of stream during the summer irrigation season is frequent.

Much of the section of South Cottonwood Creek from stream mile 6.2 to the headwaters lies within lands controlled by the U.S. Forest Service and Burlington Northern Railroad. Timber harvesting is the major land use, with ranching and farming confined to private lands along the lower two miles of this section. Commodities produced are cattle, hay and some grains.

The USGS operated a gage at stream mile 8.2 of South Cottonwood Creek from May, 1951 to September, 1953. This gage was upstream from all irrigation diversions. The mean annual flow for the 1952 and 1953 water years was 34.4 cfs. Mean monthly flows for the period of record ranged from 11.0 cfs (in March) to 120.3 cfs (in June). The SCS (Farnes and Shafer, 1972) estimated the mean annual water yield for the South Cottonwood drainage at 25,700 acre-feet (35.5 cfs).

GAME FISH PRESENT: Brook trout, rainbow trout, brown trout.

FISHERY:

Fish populations in a 1,000 ft section of South Cottonwood Creek were surveyed by electrofishing on September 4 and October 8, 1980. Game fish captured in descending order of abundance were brook, rainbow and brown trout. The mottled sculpin was the only non-game species present. The electrofishing survey data are summarized in Table 2-152.

Table 2-152. Summary of electrofishing survey data collected for a 1,000 ft section of South Cottonwood Creek (T3S, R5E, Sec. 21D) on September 4 and October 8, 1980.

Fish Species	Number Captured	Length Range (inches)
Brook trout	206	3.6 - 12.6
Rainbow trout	134	2.9 - 14.9
Brown trout	1	14.0
Mottled sculpin	-	--

The standing crop of trout was estimated using a mark-recapture method (Table 2-153). The estimate shows that this 1,000 ft section supported about 631 trout, weighing 110 pounds. Brook trout, the predominant species, accounted for 67% of the total trout numbers and 61% of the total biomass. Of the tributaries electrofished within the Gallatin drainage, South Cottonwood Creek supported one of the highest standing crops of trout.

Table 2-153. Estimated standing crop of trout in a 1,000 ft section of South Cottonwood Creek (T3S, R5E, Sec. 21D) on September 4, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.6 - 5.9	203	
	6.0 - 9.9	201	
	10.0 - 12.6	17	
		421(±88)	67(±10)
Rainbow trout	3.5 - 5.9	73	
	6.0 - 9.9	112	
	10.0 - 14.9	25	
		210(±38)	43(±7)
Total trout		631(±96)	110(±12)

WILDLIFE:

Wildlife found in the South Cottonwood drainage include elk, mule deer, white-tailed deer, moose, black bear and cougar. In the summer of 1986, a grizzly bear sow and two cubs were present in the drainage. Resident upland game birds are Hungarian partridge, ring-necked pheasant, ruffed grouse and blue grouse. Furbearers include mink, weasel, raccoon, coyote, fox and badger. Small mammals and birds common to southwestern Montana are also present.

WETTED PERIMETER:

Cross-sectional measurements were made in a 417-ft section of South Cottonwood Creek near stream mile 7.5 (Sec. 27C, T3S, R5E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 24.3, 34.5 and 85.4 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-135. Lower and upper inflection points occur at approximate flows of 6 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

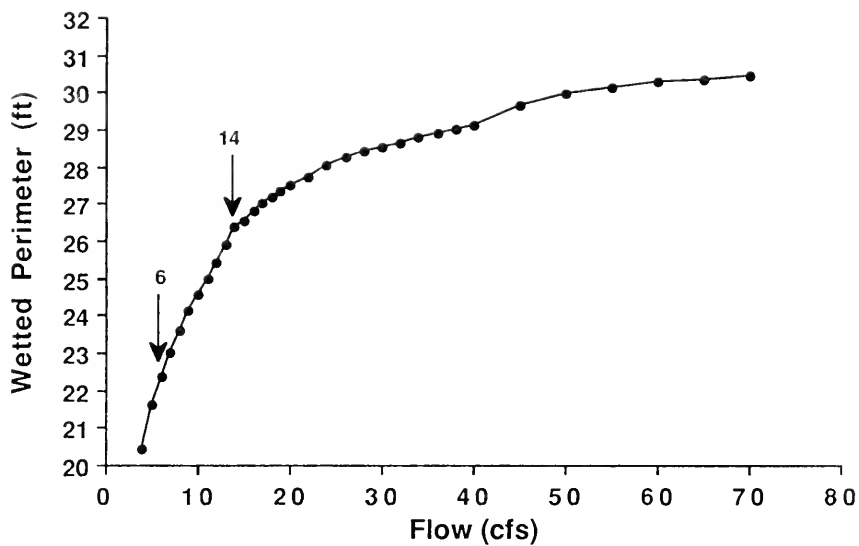


Figure 2-135. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in South Cottonwood Creek.

STREAM NAME: Baker Creek

STREAM REACH: From the Heeb Lane Bridge to the mouth - 6.2 miles

LOCATION: Sec. 36A, T1N, R3E to Sec. 1, T1N, R3E

DESCRIPTION OF STREAM REACH:

Baker Creek was originally a side channel of the Gallatin River known as the West Branch of the West Gallatin River. A dike was constructed nearly one hundred years ago at the head of the West Branch, shutting off the flow and creating what is now referred to as Baker Creek. Continual maintenance of the present dike and associated Baker Creek headgate is required to prevent the Gallatin River from recapturing its old channel. Baker Creek is about 10 miles in length, has a silt and gravel bottom and, in its lower reaches, has a mean width of about 57 ft.

The flat valley lands comprising the Baker Creek drainage are almost entirely in private ownership. Land uses are agriculturally oriented. Subdivision of lands for homesite development has increased in recent years. Water-based recreation occurs primarily on lower Baker Creek where flow is maintained year-round within the stream channel. Upper reaches are frequently dry during the summer when water is diverted to irrigate crop lands.

Surface and subsurface flow from the Gallatin River is the prime source of the water feeding Baker Creek. Flows in Baker Creek at stream mile 0.3 were measured by the USGS from December, 1951 through December, 1953. Mean monthly flows during this period ranged from 55 cfs (in August, 1953) to 606 cfs (in May, 1952). The mean annual flow for the 1953 water year, the only complete year of record, was 110 cfs.

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish.

FISHERY:

Fish populations in a 1,000 ft section of Baker Creek were surveyed by electrofishing on October 15 and 23, 1980. Game fish captured in descending order of abundance were brown trout, mountain whitefish and rainbow trout. Non-game species present were white sucker, longnose sucker and mottled sculpin. The electrofishing survey data are summarized in Table 2-154.

Table 2-154. Summary of electrofishing survey data collected for a 1,000 ft section of Baker Creek (T1N, R3E, Sec. 13) on October 15 and 23, 1980.

Fish Species	Number Captured	Length Range (inches)
Brown trout	200	3.4-20.0
Mountain whitefish	30	4.5-16.0
Rainbow trout	4	8.8-11.5
White sucker	7	4.6- 8.1
Longnose sucker	1	5.2
Mottled sculpin	-	-

The standing crop of brown trout, the predominant trout species, was estimated using a mark-recapture method (Table 2-155). The estimate shows that this 1,000 ft section supported about 209 brown trout (6.0 inches and longer), weighing 134 pounds. This estimate, however, is believed to be inflated due to the movement of brown trout spawners, presumably from the Gallatin River, into the study section. The magnitude of the resident brown trout population may, therefore, be considerably less than what the estimate shows. The populations of mountain whitefish and rainbow trout were too sparse to reliably estimate using the mark-recapture method.

Table 2-155. Estimated standing crop of brown trout in a 1,000 ft section of Baker Creek (T1N, R3E, Sec. 13) on October 15, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	6.0 - 9.9	98	
	10.0 - 20.0	<u>111</u>	<u> </u>
		209(±52)	134(±37)

A 1,000 ft section of lower Baker Creek (T1N, R3E, Sec. 12C) was electrofished on October 30, 1985 to assess the use of Baker Creek as a reproductive site by migrant brown trout from the Gallatin River. Thirteen of the larger brown trout captured (ranging in length from 12.4-19.0 inches and averaging 14.9 inches) were tagged with numbered floy tags. Numerous redds were observed in the section, mostly proximal to the stream banks.

In 1986, anglers reported catching two of the tagged brown trout - one in the Gallatin River and the other in Baker Creek. No firm conclusions can

be derived from this limited data, other than Baker Creek is used by brown trout from the Gallatin River as a reproductive site. Recent observations show that spawning use of Baker Creek by river fish is substantial. Baker Creek is likely an important contributor of young recruits to the brown trout fishery of the Gallatin River.

WILDLIFE:

White-tailed deer, raccoon, beaver, mink, otter and muskrat utilize Baker Creek and its riparian zone. Ring-necked pheasant and Hungarian partridge are found on lands adjacent to the creek. Lower Baker Creek provides some nesting habitat for waterfowl and also serves as a resting area during the spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a 100 ft section of lower Baker Creek (Sec. 12C, T1N, R3E). Five riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 20.2, 73.1 and 84.6 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-136. Lower and upper inflection points occur at approximate flows of 6 and 14 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to provide spawning and rearing habitats for migrant brown trout from the Gallatin River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 14 cfs (10,136 A.F./yr)

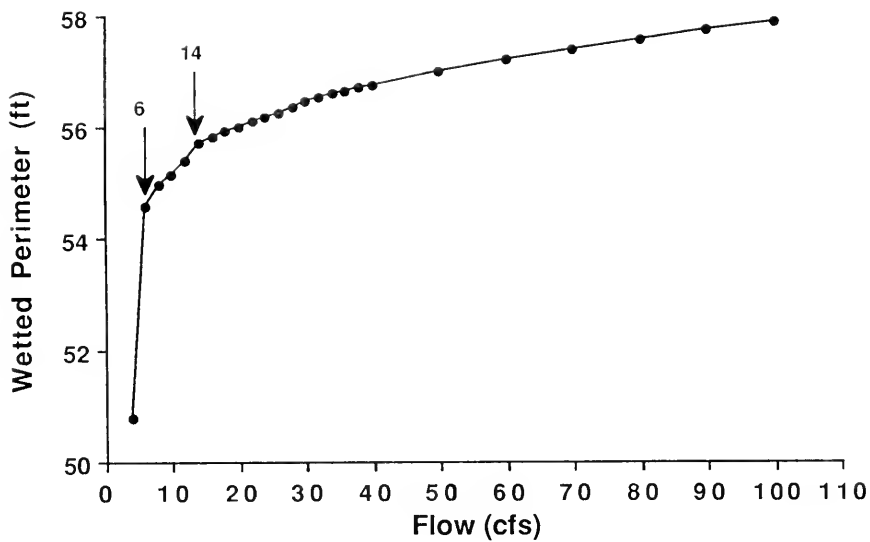


Figure 2-136. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Baker Creek.

STREAM NAME: Rocky Creek

STREAM REACH: From the confluence of Jackson Creek to the junction with Sourdough Creek - 15.0 miles

LOCATION: Sec. 15, T2S, R7E to Sec. 31, T1S, R6E

DESCRIPTION OF STREAM REACH:

Rocky Creek arises on the southwest side of the Bangtail Mountains in southwest Montana and flows 15.0 miles to the City of Bozeman where it joins Sourdough Creek to form the East Gallatin River. The creek drains about 87 square miles. Much of Rocky Creek passes through private lands in which homesite development is rapidly increasing, particularly in the Bozeman area. I-90 parallels Rocky Creek for much of its length. At low flow, lower Rocky Creek averages about 36 ft in width.

Man and his activities have brought substantial changes to Rocky Creek. Along some creek sections, overgrazing by livestock has resulted in the denuding of the streambanks, leaving them raw and easily erodible. Sections of meandering stream have been straightened and the resulting channel banks reinforced with car bodies and concrete slabs. Construction of I-90 in 1967 resulted in the replacement of 2,200 ft of Rocky Creek with a straight 1,400 ft channel.

The USGS operated a gage on Rocky Creek at stream mile 9.4 from October, 1951 to September, 1953. The mean annual flow for the 1952 and 1953 water years was 35.8 cfs. Mean monthly flows ranged from 9.6 cfs (in December, 1952) to 163 cfs (in May, 1952). Farnes and Shafer (1972) estimated the mean annual water yield for the Rocky Creek drainage at 37,000 acre-feet (51 cfs).

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout.

FISHERY:

Wells (1977), using electrofishing procedures, estimated fish populations in three sections of Rocky Creek representing three different land use practices. The rainbow trout was the most abundant game fish in the sections, followed by brown trout and a few mountain whitefish and brook trout. Other species found were longnose sucker, white sucker, mountain sucker and mottled sculpin.

The study section least altered by man's activities supported the highest trout population. The estimate for September, 1976 showed 304 age I and older rainbow and brown trout, weighing 130 pounds, per 1,000 ft of stream. The estimate for the same section in April, 1977 showed 352 age I and older trout, weighing 149 pounds. Pounds of trout in the altered sections ranged from 17-59 per 1,000 ft for the same period. Of the mountain tributary streams electrofished in the Gallatin drainage, Rocky Creek supported (in its least altered section) one of the highest standing crops of trout.

WILDLIFE:

Mule deer and white-tailed deer are the most common big game species within the Rocky Creek drainage. Common furbearers associated with the creek and its riparian zone are mink, muskrat and beaver. Some waterfowl use occurs during the spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a 585 ft section of lower Rocky Creek near its junction with Sourdough Creek (Sec. 6A, T2S, R6E). Two riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 21.7, 61.1 and 89.2 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-137. Lower and upper inflection points occur at approximate flows of 6 and 16 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to dilute the urban pollutants that enter at the City of Bozeman and are passed on to the East Gallatin River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 51 cfs (36,922 A.F./yr)

Based on the results of the wetted perimeter inflection point method, a flow of 16 cfs should be recommended for the fishery. However, a more important use of the flow of Rocky Creek is to dilute the various urban pollutants that are produced at Bozeman and passed on to the East Gallatin River - a river with a history of pollution problems (see FLOW REQUEST for Reach #1 of the East Gallatin River). Untreated pollution sources at Bozeman (industrial wastes, urban runoff, storm drains and drain fields) presently pose the greatest threat to the East Gallatin trout fishery.

To help slow the deterioration of water quality in the East Gallatin River, thus protecting the existing salmonid fishery, all remaining, unappropriated water in its upper tributaries (Sourdough, Bridger and Rocky Creeks) should remain instream for dilution purposes. At the mouth of Rocky Creek, this flow equals, during an average water year, about 36,922 acre-feet (51 cfs) (Farnes and Shafer, 1972). A flow of 51 cfs is, therefore, requested.

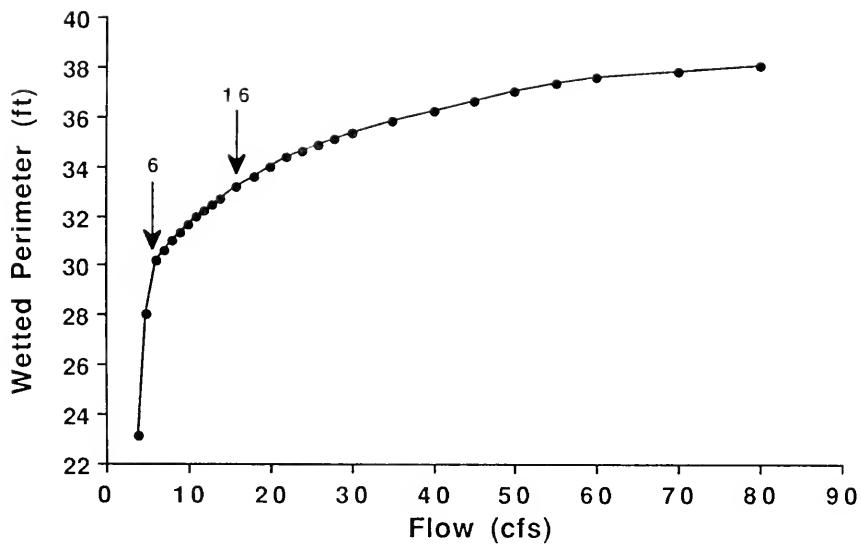


Figure 2-137. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Rocky Creek.

STREAM NAME: Sourdough (Bozeman) Creek

STREAM REACH: From Mystic Reservoir to the mouth - 16.5 miles

LOCATION: Sec. 25, T3S, R6E to Sec. 6, T2S, R6E

DESCRIPTION OF STREAM REACH:

Sourdough Creek originates at the outlet of Mystic Reservoir in the north end of the Gallatin Range of southwest Montana and flows in a northwesterly direction for 16.5 miles before joining Rocky Creek at the City of Bozeman to form the East Gallatin River. Stream elevations at the origin and mouth are approximately 6,400 and 4,720 ft, respectively. The stream gradient averages about 102 ft/mile. The lower creek averages about 18 ft in width at low flow. Sourdough Creek drains an area of about 65 square miles.

The stretch of Sourdough Creek between the mouth and stream mile 8.5 is surrounded by agricultural, industrial and municipal lands within the Gallatin Valley. Land uses include small grain production, cattle ranching, light industry and homesite development. Adjacent lands are rapidly being converted from agricultural to urban-municipal uses. Stream access within this section is restricted by private landowners. However, short sections within the City of Bozeman are accessible to the public.

The section from stream mile 8.5 to the headwaters is surrounded by forested lands within the Gallatin Mountain Range. About 6.75 miles of Sourdough Creek pass through the Gallatin National Forest. The upper drainage has been extensively logged in the past and additional timber sales are being proposed for the future. About 9 miles of controlled access road plus old logging roads, foot trails and horse trails provide public access. Mystic Reservoir, a former municipal water supply and irrigation storage facility at the head of Sourdough Creek, was breached in 1984.

Recreational activities within the drainage are primarily confined to that portion within the Gallatin National Forest. These activities include hunting, cross-country skiing, hiking, backpacking, camping and fishing.

The USGS operated a gage on Sourdough Creek at stream mile 9.9 from May, 1951 to September, 1953. The mean annual flow for the 1952 and 1953 water years was 27.9 cfs. Mean monthly flows for the period of record ranged from 7.3 cfs (in March) to 80.5 cfs (in May). Farnes and Shafer (1972) estimated the mean annual water yield of the Sourdough Creek drainage at 26,000 acre-feet (35.9 cfs).

GAME FISH PRESENT: Brook trout, rainbow trout, brown trout.

FISHERY:

A 1,000 ft section of upper Sourdough Creek was electrofished on October 16 and 22, 1980. One hundred two brook trout, ranging from 3.1-11.4 inches, and 36 rainbow trout from 4.0-11.5 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-156). The estimates show that this 1,000 ft section supported about 216 trout, weighing 28 pounds. Brook trout, the predominant trout species, comprised about 67 and 64% of the total trout numbers and biomass, respectively.

Table 2-156. Estimated standing crops of trout in a 1,000 ft section of Sourdough Creek (T3S, R6E, Sec. 7D) on October 16, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	4.5 - 5.9	67	
	6.0 - 9.9	72	
	10.0 - 11.4	5	
		144(±26)	18(±4)
Rainbow trout	4.0 - 5.9	44	
	6.0 - 9.9	18	
	10.0 - 11.5	10	
		72(±28)	10(±4)
Total trout		216(±38)	28(±6)

Trout population estimates are available for a series of study sections within lower Sourdough Creek between stream miles 0.8 and 6.5 (White et al., 1983). The rainbow trout was the most abundant trout species, followed by brook trout and a few brown trout. Mountain, longnose and common suckers were also present. Trout biomass estimates for the various sections ranged from 28.7-104.1 pounds per 1,000 ft. Trout populations within the Bozeman (urban) study sections were characterized by fewer fish as compared to the non-urban sections and an age structure in which older fish predominated. This is indicative of poor reproduction. Urban water pollution problems discussed by Blue Ribbons (1979) are the probable cause.

Overall, Sourdough Creek supports a substantial trout fishery.

WILDLIFE:

Big game species found in the Sourdough Creek drainage are elk, mule deer, white-tailed deer, moose, black bear and cougar. Furbearers such as mink, muskrat, raccoon, coyote, fox and bobcat are present. Upland game birds in the area include Hungarian partridge and ruffed and blue grouse. Sourdough Creek provides little habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of lower Sourdough Creek at the City of Bozeman. Two riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 12.3, 34.1 and 69.6 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-138. Lower and upper inflection points occur at approximate flows of 6 and 11 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to dilute the urban pollutants that enter the creek at Bozeman and are passed on to the East Gallatin River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 35.9 cfs (25,990 A.F./yr)

Based on the results of the wetted perimeter inflection point method, a flow of 11 cfs should be recommended for the fishery. However, a more important use of the flow of Sourdough Creek is to dilute the various urban pollutants that enter the creek at Bozeman and are passed on to the East Gallatin River - a river with a history of pollution problems (see FLOW REQUEST for Reach #1 of the East Gallatin River). Untreated pollution sources at Bozeman (industrial wastes, urban runoff, storm drains and drain fields) presently pose the greatest threat to the East Gallatin trout fishery.

To help slow the deterioration of water quality in the East Gallatin River, thus protecting the existing salmonid fishery, all remaining unappropriated water in its upper tributaries (Sourdough, Bridger and Rocky Creeks) should remain instream for dilution purposes. For Sourdough Creek at its mouth, this flow equals, during an average water year, about 25,990 acre-feet (35.9 cfs) (Farnes and Shafer, 1972). A flow of 35.9 cfs is, therefore, requested.

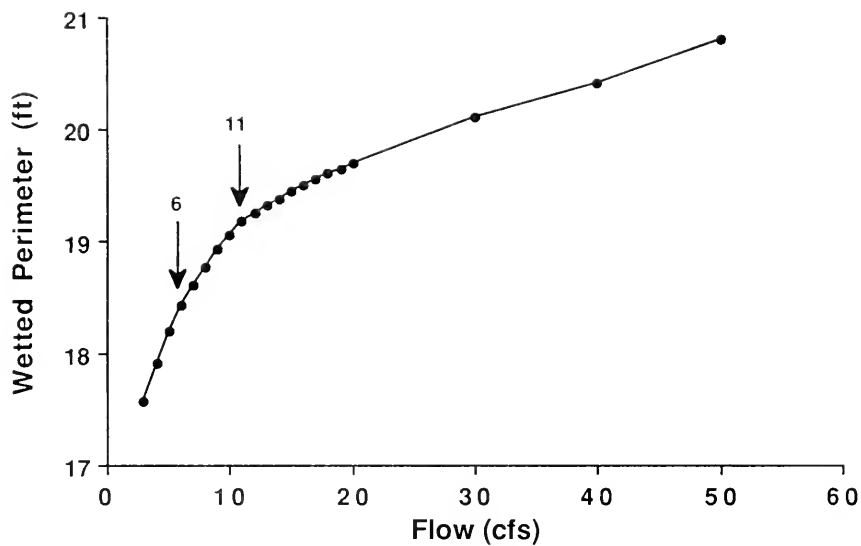


Figure 2-138. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Sourdough Creek.

STREAM NAME: Bridger Creek

STREAM REACH: From the headwaters to the mouth - 17.5 miles

LOCATION: Sec. 18, T1N, R7E to Sec. 31, T1S, R6E

DESCRIPTION OF STREAM REACH:

Bridger Creek originates in the Bridger Mountains of southwest Montana and flows for about 17.5 miles through a narrow valley to its confluence with the East Gallatin River near the City of Bozeman. It drains an area of 62.5 square miles. The stream, which averages about 23.5 ft in width in its lower reaches, has a gravel-cobble substrate. All lands surrounding the creek are privately owned.

Lands within the drainage are used primarily for logging, grazing, hay and grain production and recreation. Within the valley, the subdivision of lands for home sites is increasing.

Water is diverted from Bridger Creek to irrigate about 1,200 acres. During low water years, lower reaches can be severely dewatered during the summer irrigation season.

The USGS operated a gage on lower Bridger Creek at stream mile 3.6. The mean annual flow for the 24-year period of record (1945-69) was 36.6 cfs. Mean monthly flows of record ranged from 7.3 cfs (for January) to 152 cfs (for May).

GAME FISH PRESENT: Rainbow trout, brown trout, brook trout, mountain whitefish.

FISHERY:

A 1,000 ft section of Bridger Creek was electrofished on August 28 and 31, 1979. Game fish captured in descending order of abundance were rainbow, brown and brook trout and mountain whitefish. Longnose sucker and mottled sculpin were the only nongame species captured. The electrofishing survey data are summarized in Table 2-157.

Table 2-157. Summary of electrofishing survey data collected for a 1,000 ft section of Bridger Creek (T1S, R6E, Sec. 31) on August 28 and 31, 1979.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	97	3.1 - 12.5
Brown trout	21	3.2 - 14.5
Brook trout	2	7.5 - 7.7
Mountain whitefish	1	10.9
Longnose sucker	6	2.7 - 7.8
Mottled sculpin	-	-

The standing crop of trout in the section was estimated using a mark-recapture method (Table 2-158). The estimate shows that this 1,000 ft section supported about 199 trout, weighing 37 pounds. Rainbow trout, the predominant trout species, comprised about 93 and 78% of the total trout numbers and biomass, respectively. Brown trout accounted for the remainder. Populations of brook trout and mountain whitefish were too sparse to estimate. For a stream of its size, Bridger Creek supports a fairly substantial biomass of trout.

Table 2-158. Estimated standing crops of trout in a 1,000 ft section of Bridger Creek (T1S, R6E, Sec. 31) on August 28, 1979. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.5 - 5.9	36	
	6.0 - 9.9	140	
	10.0 - 12.5	10	
		186(±46)	29(±7)
Brown trout	10.0 - 14.4	13(±5)	8(±3)
Total trout		199(±46)	37(±8)

WILDLIFE:

Numerous big game species, including white-tailed and mule deer, elk, moose, black bear, mountain lion and mountain goat, inhabit the Bridger Creek drainage. Common furbearers include muskrat, beaver, mink, bobcat and raccoon. Blue and ruffed grouse are the resident upland game birds. Habitat for waterfowl is limited due to the stream's small size.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of lower Bridger Creek (T1S, R6E, Sec. 31) just upstream from its confluence with the East Gallatin River. Two riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 29.0, 54.6 and 94.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-139. A prominent upper inflection point occurs at an approximate flow of 14 cfs.

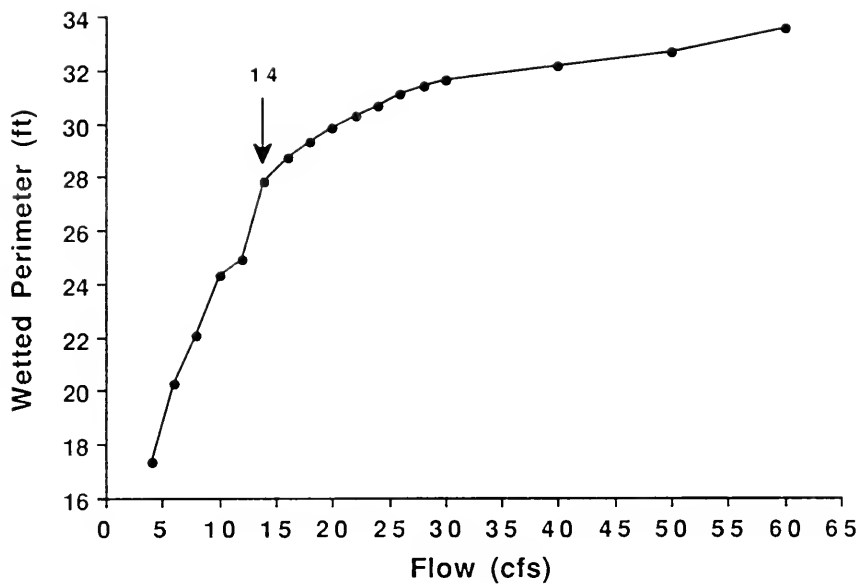


Figure 2-139. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Bridger Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain existing resident trout populations; to help dilute the urban pollutants that are produced at Bozeman and passed on to the East Gallatin River; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 36.6 cfs (26,497 A.F./yr)

Based on the results of the wetted perimeter inflection point method, a flow of 14 cfs should be recommended for the fishery. However, a more important use of the flow of Bridger Creek is to dilute the various urban pollutants that are produced at Bozeman and eventually enter the East Gallatin River - a river with a history of pollution problems (see FLOW REQUEST for Reach #1 of the East Gallatin River). Untreated pollution sources at Bozeman (industrial wastes, urban runoff, storm drains and drain fields) presently pose the greatest threat to the East Gallatin trout fishery.

To help slow the deterioration of water quality in the East Gallatin River, thus protecting the existing salmonid fishery, all remaining, unappropriated water in its upper tributaries (Sourdough, Bridger and Rocky Creeks) should remain instream for dilution purposes. At the USGS gage site on Bridger Creek, this flow equals, during an average water year, about 26,497 acre-feet (36.6 cfs).

STREAM NAME: West Fork of Hyalite Creek

STREAM REACH: From Hyalite Lake to Hyalite Reservoir - 6.6 miles

LOCATION: Sec. 23 T5S, R6E to Sec. 23, T4S, R6E

DESCRIPTION OF STREAM REACH:

The West Fork of Hyalite Creek originates in the Gallatin Range at the outlet of Hyalite Lake and flows 6.6 miles before entering Hyalite Reservoir, a 208-acre irrigation and municipal storage impoundment completed in 1951. The 11.4 square mile drainage basin, which is within the Gallatin National Forest, is characterized by steep, rugged mountains, talus slopes and coniferous forests. Much of the watershed is within the 7,000 to 9,000 foot range. Logging, livestock grazing and recreation are the major land uses within the basin.

The lower portion of the West Fork has a cobble and gravel bottom and a mean width at low flow of about 27 feet. Pool development is limited. Upper reaches are steep, with the stream cascading over numerous scenic falls.

The Montana Department of Natural Resources and Conservation, the operator of Hyalite Dam, maintains a flow gage on the West Fork at stream mile 1.0. The mean annual flow for an 8-year period from 1975 through 1983 was 28.9 cfs and the base winter flow was 7.8 cfs.

GAME FISH PRESENT: Brook trout, Yellowstone cutthroat trout, arctic grayling.

FISHERY:

Hyalite Reservoir, which the West Fork of Hyalite Creek flows into, supports an excellent sport fishery. The proximity to Bozeman and ease of access make this fishery extremely important to the local community. The reservoir is noted for producing an abundance of pan-size cutthroat trout with a few lunkers to six pounds occasionally caught - and trophy-size arctic grayling. Grayling have a limited distribution in Montana, being primarily restricted to relatively inaccessible, high mountain lakes. The large size of the Hyalite grayling (a 2 pound 10 $\frac{1}{4}$ ounce grayling was caught in the reservoir in 1986, establishing a new Montana record), coupled with the easy public access, greatly enhances the value of the reservoir to the angling public.

Angler use of the reservoir is substantial. Fishing pressure in 1981 was estimated at 19,981 hours and 17,733 hours in 1982 (Zubik, 1983). Anglers harvested an estimated 6,064 fish in 1981 and 4,204 fish in 1982 (Zubik, 1983).

The East and West Forks of Hyalite Creek are the only tributaries providing spawning habitat for the reservoir fish populations. Maintenance of these spawning areas is crucial to the survival of the arctic grayling population, which depends solely on natural reproduction to sustain its numbers. The MDFWP's management objective for the Hyalite cutthroat trout is

to maintain a high quality sport fishery that allows for a liberal harvest. Consequently, annual hatchery plants of about 20,000 cutthroat fry are needed to augment natural reproductive levels. The existing cutthroat spawning habitat is extremely important in producing fish to help meet this management objective.

Cutthroat spawners begin entering the East and West Forks in early June, with spawning occurring in June and July. After spawning, the adults return to the reservoir. The eggs incubate in the stream gravel for about 30 days before hatching. The young, called sac fry, remain in the gravel until late August to late September when they emerge and move downstream to the reservoir. Once in the reservoir, the fry grow to adulthood, typically reaching sexual maturity in 3 or 4 years when they spawn for the first time. In 1982, about 87% of the total fry production for Hyalite Reservoir was contributed by the West Fork (Zubik, 1983).

The arctic grayling life cycle is similar to that of the cutthroat trout. Almost all Hyalite grayling spawn in the West Fork in the 1,300 feet of stream immediately upstream from the head of the reservoir. The maintenance of the West Fork's spawning habitat is crucial to the survival of the reservoir grayling population.

In addition to providing spawning habitat for the reservoir fish populations, the East and West Forks also support year-round populations of resident brook and cutthroat trout. These fish are few in number and small in size, providing limited recreational opportunities.

WILDLIFE:

Almost all big game species found in southwest Montana, including an occasional grizzly bear, are periodic and/or seasonal inhabitants of the West Fork drainage. The drainage is particularly noted for its high density moose population. The willow flat along the lower portion of the West Fork at the head of Hyalite Reservoir is used extensively by foraging moose. Blue and ruffed grouse and many furbearers, including mink, marten, bobcat and wolverine, are also present. The West Fork is too small and precipitous to provide habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a 139-foot section of the West Fork of Hyalite Creek located at about stream mile 0.5 (Sec. 26BB, T4S, R6E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 12.1, 22.0 and 68.7 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-140. Lower and upper inflection points occur at approximate flows of 7 and 12 cfs, respectively.

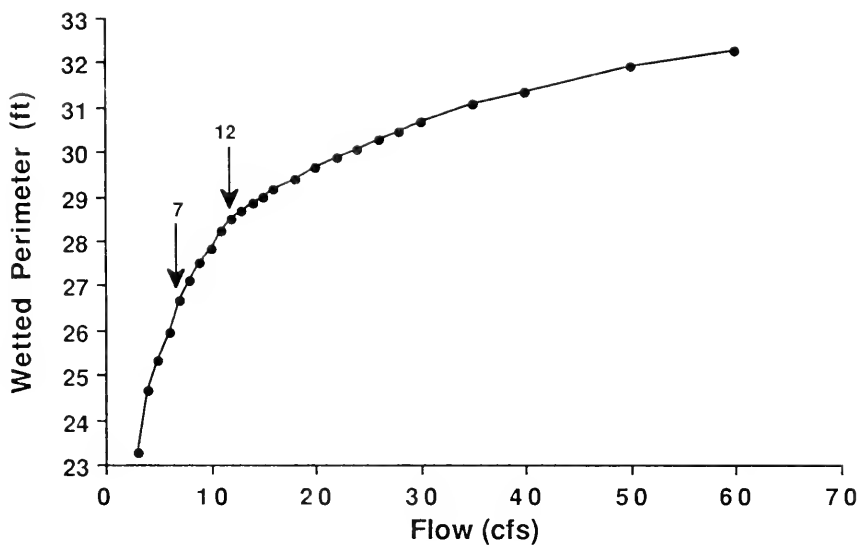


Figure 2-140. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in the West Fork of Hyalite Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain crucial spawning habitat for the cutthroat trout and arctic grayling populations of Hyalite Reservoir; to sustain the existing resident trout population; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 12 cfs (8,688 A.F./yr)

STREAM NAME: East Fork of Hyalite Creek

STREAM REACH: From Heather Lake to Hyalite Reservoir - 6.8 miles

LOCATION: Sec. 12, T5S, R6E to Sec. 23, T4S, R6E

DESCRIPTION OF STREAM REACH:

The East Fork of Hyalite Creek originates in the Gallatin Range at the outlet of Heather Lake and flows 0.6 miles to Emerald Lake. From Emerald Lake it flows 6.2 miles before discharging into Hyalite Reservoir, a 208-acre irrigation and municipal storage impoundment completed in 1951. The drainage basin, which is entirely within the Gallatin National Forest, is characterized by steep, rugged mountains, talus slopes and coniferous forests. Much of the watershed is within the 7,000 to 9,000 foot range. Logging, livestock grazing and recreation are the major land uses within the basin.

The lower portion of the East Fork has a cobble and gravel bottom and a mean width at low flow of about 17.5 feet. Pool development is limited. Upper reaches are steep, with the stream flow plunging from pool to pool.

The Montana Department of Natural Resources and Conservation, the operator of Hyalite Dam, maintains a flow gage on the East Fork at stream mile 1.1. The mean annual flow for a 7-year period from 1975 through 1981 was 15.8 cfs and the base winter flow was 2.6 cfs.

GAME FISH PRESENT: Brook trout, Yellowstone cutthroat trout, arctic grayling.

FISHERY:

Hyalite Reservoir, which the East Fork of Hyalite Creek flows into, supports an excellent sport fishery. The proximity to Bozeman and ease of access make this fishery extremely important to the local community. The reservoir is noted for producing an abundance of pan-size cutthroat trout (with a few lunkers to six pounds occasionally caught) and trophy-size arctic grayling. Grayling have a limited distribution in Montana, being primarily restricted to relatively inaccessible, high mountain lakes. The large size of the Hyalite grayling (a 2 pound 10½ ounce grayling was caught in the reservoir in 1986, establishing a new Montana record), coupled with the easy public access, greatly enhances the value of the reservoir to the angling public.

Angler use of the reservoir is substantial. Fishing pressure in 1981 was estimated at 19,981 hours and 17,733 hours in 1982 (Zubik, 1983). Anglers harvested an estimated 6,064 fish in 1981 and 4,204 fish in 1982 (Zubik, 1983).

The East and West Forks of Hyalite Creek are the only tributaries providing spawning habitat for the reservoir fish populations. Maintenance of these spawning areas is crucial to the survival of the arctic grayling population, which depends solely on natural reproduction to sustain its numbers. The MDFWP's management objective for the Hyalite cutthroat trout is to maintain a high quality sport fishery that allows for a liberal harvest.

Consequently, annual hatchery plants of about 20,000 cutthroat fry are needed to augment natural reproductive levels. The existing cutthroat spawning habitat is extremely important in producing fish to help meet this management objective.

Cutthroat spawners begin to ascend the East and West Forks in early June, with spawning occurring in June and July. After spawning, the adults return to the reservoir. The eggs incubate in the stream gravel for about 30 days before hatching. The young, called sac fry, remain in the gravel until late August to late September when they emerge and move downstream to the reservoir. Once in the reservoir, the fry grow to adulthood, typically reaching sexual maturity in 3 or 4 years when they spawn for the first time. In 1982, about 13% of the total fry production for Hyalite Reservoir was contributed by East Fork (Zubik, 1983).

The arctic grayling life cycle is similar to that of the cutthroat trout. A few grayling spawn in the East Fork; however, reproduction is limited and the contribution of fry to the reservoir population is low.

In addition to providing spawning habitat for the reservoir fish populations, the East and West Forks also support year-round populations of resident brook and cutthroat trout. These fish are few in number and small in size, providing limited recreational opportunities.

WILDLIFE:

Almost all big game species found in southwest Montana, including an occasional grizzly bear, are periodic and/or seasonal inhabitants of the East Fork drainage. The drainage, however, is particularly noted for its high density moose population. Blue and ruffed grouse and many furbearers, including mink, marten, bobcat and wolverine, are also present. The East Fork is too small and precipitous to provide habitat for waterfowl.

WETTED PERIMETER:

Cross-sectional measurements were made in a 348-foot section of the East Fork Hyalite Creek near its confluence with Hyalite Reservoir (Sec. 23BD, T4S, R6E). Five riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 9.0, 16.4 and 55.7 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-141. Lower and upper inflection points occur at approximate flows of 4 and 7 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain spawning habitat for the game fish populations of Hyalite Reservoir; to sustain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 7 cfs (5,068 A.F./yr)

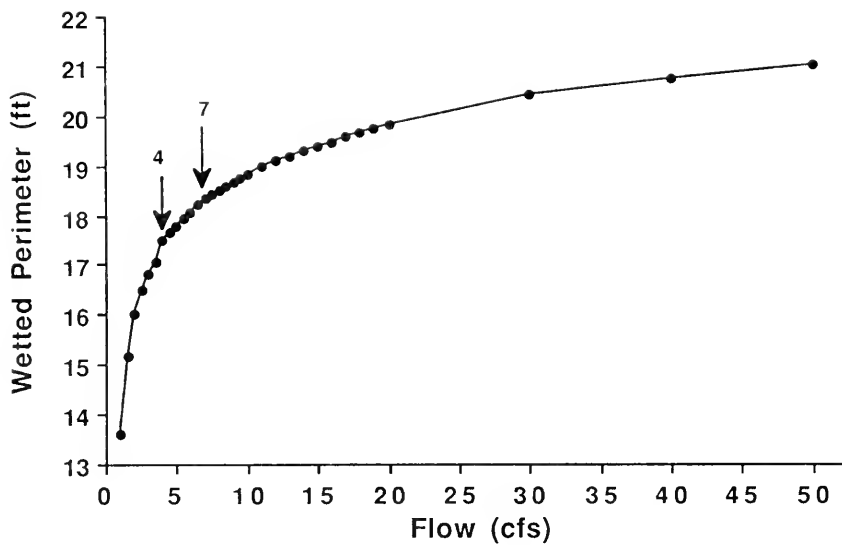


Figure 2-141. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in the East Fork of Hyalite Creek.

STREAM NAME: Hyalite (Middle) Creek

DESCRIPTION OF BASIN:

Hyalite Creek originates at the outlet of Middle Creek (Hyalite) Reservoir in the northwest portion of the Gallatin Range of southwest Montana. The stream heads at an elevation of 6,700 ft and flows in a northwesterly direction for 28.5 miles before discharging into the East Gallatin River. Stream gradient averages about 154 ft/mile. Hyalite Creek drains an area of about 118 square miles.

The section of Hyalite Creek between the mouth and stream mile 20.5 lies primarily within agricultural lands within the Gallatin Valley. Major commodities produced are cattle, grains and alfalfa hay. Access to this section is controlled by adjacent private landowners. About 10,168 acres of land are irrigated with water diverted from Hyalite Creek and its tributaries. Consequently, much of this section is severely dewatered during the summer irrigation season.

The section from about stream mile 20.5 to the headwaters is surrounded by densely forested lands within the Gallatin Range. Approximately 17.5 miles of upper Hyalite Creek are within the Gallatin National Forest. Access to Middle Creek Reservoir and the upper drainage is provided by a USFS road that was paved in 1987. Logging roads and established foot and horse trails provide additional access into the upper drainage. Primary land uses include timber harvesting, livestock grazing and recreation.

Middle Creek Reservoir, which has a usable storage capacity of 8,030 acre-feet, regulates the flow of Hyalite Creek. The reservoir was built in 1951 for irrigation and municipal purposes. Municipal water is diverted from Hyalite Creek by the City of Bozeman approximately 8 miles downstream from the reservoir.

Recreational activities within the drainage are confined mainly to lands within the Gallatin National Forest. This includes over 17 miles of Hyalite Creek plus tributaries and Middle Creek (Hyalite) Reservoir. Recreational activities include hunting, fishing, camping, backpacking, sightseeing, snowmobiling, cross-country skiing, picnicking, trail bike riding, horseback riding and firewood gathering.

STREAM NAME: Hyalite (Middle) Creek

STREAM REACH: #1. From Middle Creek (Hyalite) Dam to the Middle Creek Ditch intake - 11.1 miles

LOCATION: Sec. 15, T4S, R6E to Sec. 3, T3S, R5E

DESCRIPTION OF STREAM REACH:

As Hyalite Creek leaves Hyalite Canyon and passes into the Gallatin Valley, flow is progressively depleted. The lowermost boundary of Reach #1 is about the lowest point where flow is commonly maintained year-round within the channel.

The USGS has operated a gage within Reach #1 at stream mile 20.8 of Hyalite Creek since 1895. The mean annual flow for a 47-year period of record was 67.2 cfs. Mean monthly flows ranged from 18 cfs (for the months of January, February and March) to 225 cfs (in June).

GAME FISH PRESENT: Rainbow trout, brook trout, cutthroat trout.

FISHERY:

A 1,000 ft section of upper Hyalite Creek within the Gallatin National Forest was electrofished on September 5 and October 8, 1980. Two hundred eighty-four rainbow trout, ranging from 3.3-17.6 inches, and one 7.6 inch brook trout were captured. The mottled sculpin was the only other species present.

The standing crop of rainbow trout, the predominant trout species, was estimated using a mark-recapture method (Table 2-159). The estimate shows that this 1,000 ft section supported about 624 rainbow trout (3.3 inches and longer), weighing 75 pounds. Of the tributary streams electrofished in the Gallatin drainage, Hyalite Creek supported one of the highest populations of rainbow trout.

A few cutthroat trout, believed to be drifters from Hyalite Reservoir, inhabit the upper stream.

Table 2-159. Estimated standing crop of trout in a 1,000 ft section of Hyalite Creek (T3S, R5E, Sec. 23D) on September 5, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	3.3 - 5.9	342	
	6.0 - 9.9	261	
	10.0 - 17.6	21	
		624(±115)	75(±15)

WILDLIFE:

Big game animals found in the upper, forested portion of the Hyalite drainage include elk, mule deer, moose, black bear and mountain lion. The upper drainage is particularly noted for its high density moose population. Furbearers such as mink, muskrat, beaver, marten, bobcat, coyote and weasel inhabit the upper basin. Within the valley portion of Reach #1, white-tailed deer are found along with an occasional mule deer, black bear and moose.

Upland game birds present are ruffed and blue grouse and, in the valley, Hungarian partridge and a few ring-necked pheasants. Waterfowl use of Hyalite Creek is limited.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of upper Hyalite Creek in Sec. 14BC, T3S, R5E. Three riffle cross-sections were established. However, two cross-sections were eliminated due to calibration problems. The WETP program was calibrated to field data collected at flows of 17.2, 52.0 and 87.1 cfs.

Additional cross-sectional data were collected in Sec. 10, T3S, R5E downstream from the above site. Two riffle cross-sections were established. One cross-section was discarded due to calibration problems. The WETP program was calibrated to field data collected at flows of 20.7, 61.9 and 102.0 cfs.

The wetted perimeter-flow relationship for the composite of two riffle cross-sections (Figure 2-142) shows lower and upper inflection points at about 14 and 28 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 28 cfs (20,271 A.F./yr)

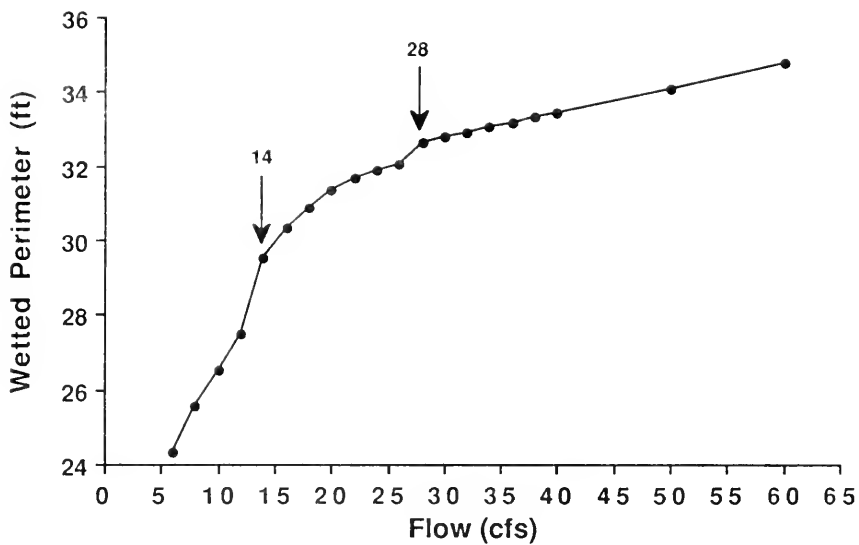


Figure 2-142. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #1 of Hyalite Creek.

STREAM NAME: Hyalite (Middle) Creek

STREAM REACH: #2. From the I-90 bridge near Belgrade to the mouth - 4.1 miles

LOCATION: Sec. 17, T1S, R5E to Sec. 32, T1N, R5E

DESCRIPTION OF STREAM REACH:

Groundwater and irrigation return flows rejuvenate lower Hyalite Creek, providing a year-round, continuous flow. At the upstream boundary of Reach #2, the channel is wetted year-round and remains so to the confluence with the East Gallatin River - a distance of 4.1 miles.

The SCS (Farnes and Shafer, 1972) estimated the mean annual water yield for the Hyalite drainage at 50,300 acre-feet (69.5 cfs).

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish, brook trout.

FISHERY:

A 1,000 ft section of lower Hyalite Creek near its mouth was electrofished on August 28 and 31, 1979. Game fish captured during the two passes were rainbow, brown and brook trout and mountain whitefish. Non-game species present were longnose, white and mountain sucker and longnose dace. Longnose suckers were particularly abundant in the section. The electrofishing survey data are summarized in Table 2-160. Due to the low numbers of fish captured, a population estimate could not be obtained.

Table 2-160. Summary of electrofishing survey data collected for a 1,000 ft section of lower Hyalite Creek (T1N, R5E, Sec. 32) on August 28 and 31, 1979.

Species	Number Captured	Length Range (inches)	Mean Length (inches)
Brown trout	18	6.6 - 16.7	10.3
Rainbow trout	17	6.5 - 12.4	9.5
Mountain whitefish	7	4.7 - 15.1	11.1
Brook trout	2	6.7 - 7.0	6.9
Longnose sucker	-	-	-
White sucker	-	-	-
Mountain sucker	-	-	-
Longnose dace	-	-	-

WILDLIFE:

White-tailed deer, raccoon, beaver, mink and muskrat utilize lower Hyalite Creek and its riparian zone. Game birds within the lower basin include ring-necked pheasant and Hungarian partridge. Lower Hyalite Creek receives some use by waterfowl during the spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a 168 ft section of lower Hyalite Creek near its mouth (Sec. 32, T1N, R5E). Two riffle cross-sections were established in this section. The WETP program was calibrated to field data collected at flows of 42.5 and 101.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-143. Lower and upper inflection points occur at approximate flows of 16 and 40 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 16 cfs (11,583 A.F./yr)

Stream dewatering and other environmental problems that plague lower Hyalite Creek have severely impacted the fishery. Because there is little hope for recovery, the flow at the lower inflection point (16 cfs) is requested.

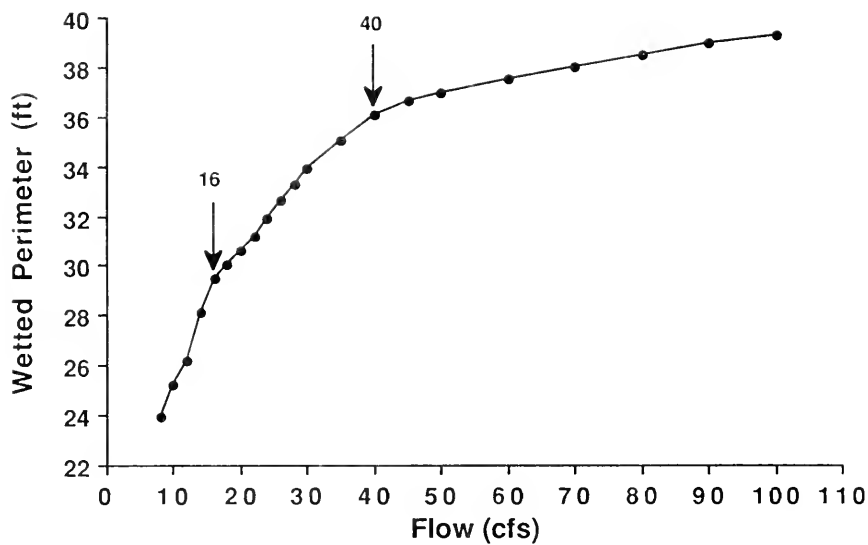


Figure 2-143. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #2 of Hyalite Creek.

STREAM NAME: Reese Creek

STREAM REACH: From the confluence of Bill Smith Creek to the mouth - 5.0 miles

LOCATION: Sec. 11, T1N, R5E to Sec. 18, T1N, R5E

DESCRIPTION OF STREAM REACH:

Reese Creek has its headwaters on the west slope of the Bridger Mountain Range, then flows across the Gallatin Valley for about eight miles before joining Ross Creek, a tributary to the East Gallatin River. Within the Gallatin Valley, Reese Creek flows through flat, open agricultural lands used for grazing, hay and small grain production and, in recent years, homesite development. Riparian habitat is considered good, with over 50% of the banks covered by woody plants. Water quality is in general poor, with high sediment loads and fecal coliform levels in excess of state standards (Blue Ribbons, 1978). Mean channel width of Reese Creek is about 15 ft.

Flow in Reese Creek is depleted for irrigation. However, groundwater sources and irrigation returns augment flow as the stream progresses through the valley, preventing the total dewatering of the creek. This sub-surface inflow tends to stabilize the year-round flow, thus giving Reese Creek a flow pattern resembling that of a spring-fed creek.

The USGS operated a gage at stream mile 4.5 of Reese Creek from June, 1951 to September, 1953. Mean monthly flows for the period of record ranged from 5.4 cfs (in February, 1952) to 77.2 cfs (in June, 1953). The mean annual flow for the 1952 and 1953 water years was 14.1 cfs.

GAME FISH PRESENT: Brown trout, rainbow trout, brook trout.

FISHERY:

A 1,000 ft section of Reese Creek was electrofished on October 15 and 22, 1980. Two hundred twenty-nine brown trout, ranging from 3.2-19.1 inches, 32 rainbow trout from 3.3-11.5 inches, and 7 brook trout from 4.7-9.8 inches were captured. The mottled sculpin was the only non-game species present.

The standing crops of brown and rainbow trout in the section were estimated using a mark-recapture method (Table 2-161). The estimates show that this 1,000 ft section supported over 576 trout, weighing about 68 pounds. Brown trout, the predominant trout species, accounted for about 95 and 88% of the total trout numbers and biomass, respectively. The population of brook trout was too sparse to estimate using mark-recapture procedures. For a stream of its size, Reese Creek supports a substantial trout population.

Table 2-161. Estimated standing crops of trout in a 1,000 ft section of Reese Creek (T1N, R5E, Sec. 10) on October 15, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brown trout	3.2 - 5.9	437	
	6.0 - 9.9	61	
	10.0 - 12.9	50	
	13.0 - 19.1	a)	
		<u>548(±163)</u>	<u>60(±9)</u>
Rainbow trout	4.5 - 5.9	5	
	6.0 - 9.9	16	
	10.0 - 11.5	<u>7</u>	
		<u>28(±6)</u>	<u>8(±2)</u>
Total trout		576(±163)	68(±9)

a) An estimate for this length group is unavailable due to an inadequate number of recaptures.

WILDLIFE:

Mule deer and white-tailed deer are the most common big game species within the Reese Creek drainage. The headwater area provides some summer range for elk. Mountain goats inhabit the steep slopes of the extreme headwaters. Furbearers within the basin include beaver, muskrat, mink and bobcat. Some habitat for waterfowl is provided during spring and fall migrations.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of Reese Creek at about stream mile 4 (Sec. 10, T1N, R5E). Two riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 17.1 and 46.4 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-144. A sharp upper inflection point occurs at 5.0 cfs.

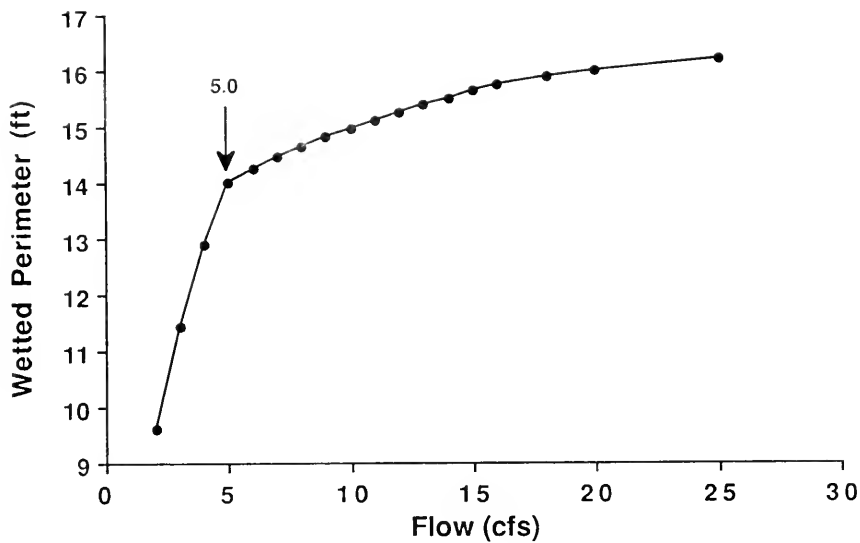


Figure 2-144. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reese Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5.0 cfs (3,620 A.F./yr)

STREAM NAME: Thompson Spring Creek

STREAM REACH: From the county road crossing in Sec. 30, T1N, R5E to the mouth - 4.5 miles

LOCATION: Sec. 30, T1N, R5E to Sec. 13, T1N, R4E

DESCRIPTION OF STREAM REACH:

Thompson Spring Creek arises in the Gallatin Valley east of Belgrade, Montana and flows 6.8 miles in a northerly direction before entering the East Gallatin River. Private lands adjacent to the creek are used for cattle grazing, hay production and, in recent years, homesite development. The streambanks are either vegetated with scattered willow and alder or open due to intense cattle use. Overuse by cattle has caused extensive bank erosion and the filling in of the channel with sediments. The end result is a wide, shallow channel having little overhead cover for trout and lacking the clean gravel areas needed for trout reproduction and the production of trout food organisms. Habitat has dramatically improved on a stretch of creek that has been fenced in recent years to exclude livestock from the banks.

In 1979, physical measurements were made on a 300 ft section of Thompson Spring Creek located about midway between the mouth and headwaters. The mean channel width was 30 ft and the mean thalweg depth was 0.8 ft. About 6% of the creek bottom consisted of exposed gravel-cobble, while the remainder was covered with a layer of sediment ranging from 0.1 to 2.0 ft in thickness.

From October, 1951 to December, 1953, the USGS operated a gage at stream mile 0.5 of Thompson Spring Creek. Mean monthly flows for the period of record ranged from 19.3 cfs (in April, 1953) to 47.6 cfs (in April, 1952). The mean annual flow for the 1952 water year was 34.3 cfs and 29.8 cfs for the 1953 water year. Sub-surface water sources provide fairly stable, year-round flows in Thompson Spring Creek.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout.

FISHERY:

Rainbow trout, brown trout, mountain whitefish and an occasional brook trout comprise the sport fish in Thompson Spring Creek. Brown and rainbow trout occasionally reach weights of 4 to 5 pounds, but few exceed 2 pounds and 18 inches.

In July, 1967, a population estimate was made for a 7,920 ft section of Thompson Spring Creek (Vincent, 1968). The creek supported an estimated 75 brown and rainbow trout (about 6 inches and longer), weighing 29 pounds, per 1,000 ft of stream. Yearling trout predominated, comprising about 68% of the estimate. Young-of-the-year trout, while not estimated, were abundant. A later estimate in 1979 showed about 266 trout (about 3 inches and longer), weighing 49 pounds, per 1,000 ft. Rainbow trout predominated, comprising 91% of the estimated trout numbers and 77% of the biomass. In recent years, land use changes have resulted in substantial habitat improvements in a portion of Thompson Spring Creek and fishermen report a much improved sport fishery.

WILDLIFE:

Big game animals found along the creek are mule deer and white-tailed deer. Resident upland game birds are Hungarian partridge and ring-necked pheasant. The greater sandhill crane is commonly observed in surrounding fields in summer. Heavy waterfowl use occurs during the fall and winter months. Blue-winged teal and mallards commonly nest along the creek.

FLOW REQUEST: January 1-December 31 -- 29 cfs (20,995 A.F./yr)

Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in spring creeks be maintained for instream uses. For Thompson Spring Creek, this flow, as derived by the USGS, amounts to about 20,995 acre-feet per year (29 cfs). A flow of 29 cfs is, therefore, requested.

STREAM NAME: Ben Hart Spring Creek

STREAM REACH: From the headwaters to the mouth - 2.5 miles

LOCATION: Sec. 24, T1N, R4E to Sec. 11, T1N, R4E

DESCRIPTION OF STREAM REACH:

Ben Hart Spring Creek arises in the Gallatin Valley north of Belgrade, Montana and flows 2.5 miles in a northerly direction before entering the East Gallatin River. This is one of the largest and least degraded spring creeks within the East Gallatin spring creek complex.

Ben Hart Spring Creek is surrounded by private lands used primarily for cattle grazing and hay and small grain production. The stream banks are either vegetated with scattered willows and alders or open due to intense cattle use. The bottom type is primarily sand-gravel. Much of the bottom is covered by a layer of sediments and mats of aquatic vegetation. The gradient averages about 14 ft per mile and channel widths range from 15-30 ft. Access to the creek is provided by permission of the landowner.

Sub-surface water sources provide fairly stable, year-round flows in Ben Hart Spring Creek. Numerous wet areas were ditched to drain into the creek. Flow is, therefore, greater than what naturally occurred. No irrigation diversions presently exist on the creek.

The USGS operated a gage at stream mile 0.5 of Ben Hart Spring Creek from October, 1951 to December, 1953. Mean monthly flows for the period of record ranged from 25.5 cfs (in March, 1952) to 38.1 cfs (in May, 1952). The mean annual flow for the 1952 water year was 31.6 cfs and 31.2 cfs for the 1953 water year.

GAME FISH PRESENT: Rainbow trout, brown trout, brook trout, mountain whitefish.

FISHERY:

Brown trout, rainbow trout and an occasional brook trout and mountain whitefish comprise the resident sport fish in Ben Hart Spring Creek. Brown and rainbow trout occasionally reach weights of 4 to 5 pounds, but few exceed 2 pounds. The magnitude of this population has not been evaluated in electrofishing surveys.

WILDLIFE:

Big game animals found along the creek are mule deer and white-tailed deer. Resident upland game birds are Hungarian partridge and ring-necked pheasant. The greater sandhill crane is commonly observed in surrounding fields in summer. Heavy waterfowl use occurs during the fall and winter months. Blue-winged teal and mallards commonly nest along the creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 29 cfs (20,995 A.F./yr)

Spring creeks are highly productive aquatic resources that have the potential to provide outstanding habitat for trout and waterfowl. Due to the unique features of the spring creek environment and their high recreational value, all effort should be made to prevent the further degradation of the few remaining spring creeks in southwest Montana. It is, therefore, recommended that the base flow in spring creeks be maintained for instream uses. For Ben Hart Spring Creek, this flow, as derived by the USGS, amounts to about 20,995 acre-feet per year (29 cfs).

STREAM NAME: East Gallatin River

GENERAL DESCRIPTION OF BASIN:

The free-flowing East Gallatin River originates at Bozeman, Montana at the junction of Rocky and Sourdough Creeks and flows 37.4 miles in a northwesterly direction to Manhattan, Montana where it joins the Gallatin River. The river meanders through the Gallatin Valley, one of the richest agricultural areas in Montana. Wheat, barley, oats, alfalfa and hay are the major crops. Considerable grazing also occurs. Along the upper river, homesite development is increasing.

The river drains an area of 642 square miles. Gradient averages 16.8 ft per mile. The bottom substrate consists primarily of cobble, gravel and silt. Riparian vegetation, which consists of grasses, willow, alder, chokecherry, cottonwood and various shrubs, has been removed along many portions of the river. As a result, eroding and riprapped banks are common. A serious sediment problem, especially in the lower 15 miles of the river, is the direct result of poor land use practices.

There are about nine major tributaries to the East Gallatin River. Numerous spring creeks enter the lower 15 miles of river.

Water chemistry of the East Gallatin River has been described by a number of authors. In general, water quality ranges from poor to good. Sewage effluents from the City of Bozeman have, in the past, elevated nitrate, phosphate and ammonia levels in the upper portion of the river, severely impacting aquatic organisms.

Access to the river is limited since virtually all the land adjacent to the river is privately owned. The present landowner attitude allows for reasonable access. Floating is a popular activity on the East Gallatin River during the fishing and waterfowl seasons.

The sport fishery of the East Gallatin River is classified by the Montana Department of Fish, Wildlife and Parks as class 2 or "Red Ribbon." Between April, 1983 and May, 1984, fishing pressure in fisherman-days was estimated at 6,474 (MDFWP, 1984). Like all Montana rivers, the East Gallatin is managed as a wild trout fishery with no stocking of hatchery trout.

STREAM NAME: East Gallatin River

STREAM REACH: #1. From the convergence of Rocky and Sourdough Creeks to the Bozeman Sewage Treatment Plant Outlet - 5.1 miles

LOCATION: Sec. 31, T1S, R6E to Sec. 26, T1S, R5E

DESCRIPTION OF STREAM REACH:

The East Gallatin in Reach #1 meanders through the upper Gallatin Valley. Gradient averages 25.4 ft per mile and sinuosity is 1.32. The river is characterized by a riffle-pool sequence, with pools ranging up to 8 ft in depth. The bottom substrate consists of cobble-gravel, with deposits of silt and other organic material in the pools. Portions of the river bank have been altered, leaving eroded banks. Rock riprap is also common. Adjacent lands in the Bozeman area have been subdivided for homesite and industrial developments. Livestock grazing, wheat farming and hay production are other common land uses. A golf course and sewage treatment plant border the lower portion of Reach #1.

The USGS operated a flow gage (#06048000) at the head of Reach #1 (500 ft downstream from the confluence of Rocky and Sourdough Creeks) from 1939-1961. The mean annual flow for the 22-year period of record was 84.7 cfs. Mean monthly flows ranged from 39 cfs (in January) to 236 cfs (in May). The mean annual flow at the downstream boundary of Reach #1 (at the sewage plant outlet) can be estimated by adding the mean annual flow for Bridger Creek - the only major tributary to Reach #1 below its origin - to the above mean. The mean annual flow of Bridger Creek, as derived at USGS gage #06048500 for a 24-year period of record (1945-1969) was 36.6 cfs. Adding these two values provides an estimated mean annual flow of 121.3 cfs at the sewage plant outlet.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout, cutthroat trout.

FISHERY:

The rainbow trout, the predominant trout species in Reach #1, occasionally reach weights of 3-5 pounds, although few exceed 2 pounds. Brown trout are also present, with fish of 1-2 pounds commonly taken by anglers. Brown trout as large as 8.7 pounds have been captured by Department personnel during recent electrofishing surveys. Mountain whitefish and a few brook and cutthroat trout are also present.

In 1971, the Manley study section was established in Reach #1 to monitor the effect of improved water quality on the wild trout population of the East Gallatin River. Prior to the 1971 upgrading of the Bozeman sewage treatment plant, effluent was discharged upstream from this section. After the upgrade, the outlet was moved downstream to a site below the section. Variations in the trout populations since 1971 are shown in Figure 2-145. The increase through 1982 is believed to reflect water quality improvements. In the summer of 1983, the rainbow trout population crashed in the Manley section as well as those study sections below the present sewage outfall.

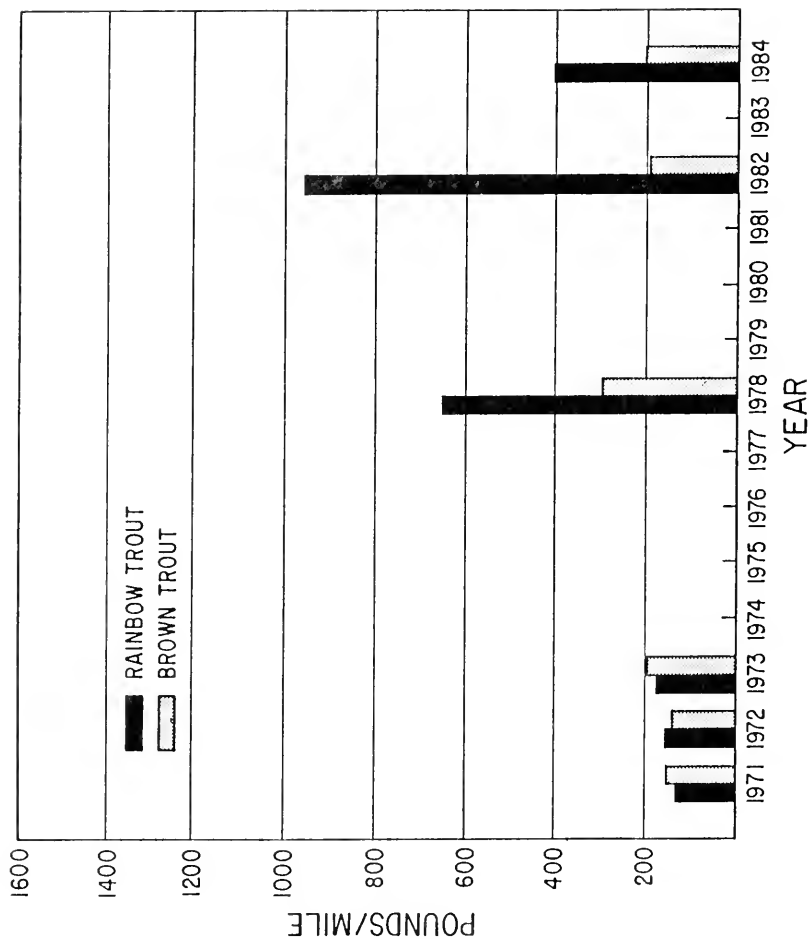


Figure 2-145. Comparison of fall estimate of biomass (pounds/mile) of adult trout in the Manley section of the East Gallatin River (from Vincent, 1985).

While the cause has not been identified, an industrial pollution source at Bozeman is suspected.

The estimated population was highest in the fall of 1982 when a mile of the study section supported about 1,167 pounds of 5 inch and longer trout. This is a substantial population for a river the size of the East Gallatin.

WILDLIFE:

Big game animals found within the floodplain of Reach #1 are mule deer, white-tailed deer and an occasional black bear. Upland game birds include ruffed grouse, Hungarian partridge and ring-necked pheasant. Mink, beaver, muskrat, red fox and raccoon are associated with the river and its riparian area.

Waterfowl use the river extensively during spring and fall migrations. Nesting waterfowl include mallard, blue-winged teal and common merganser. Mergansers and goldeneyes are common winter residents.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain existing resident trout populations; to dilute the various pollutants that enter the river at Bozeman, as well as the effluent discharged at the sewage treatment facility; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 121.3 cfs (87,817 A.F./yr)

Upgrades in the Bozeman sewage treatment facility have greatly improved the quality of plant discharges, eliminating sewage pollution as the major limiting factor for the East Gallatin trout population. As Bozeman continues to grow, the existing treatment plant could become overloaded and water quality deteriorate to the point where fish and other aquatic organisms are again impacted. However, a far greater threat to the fishery is the untreated pollution that enters the river at Bozeman. Storm runoff, storm drains, industrial wastes and urban drain fields are constant threats to water quality. The crash of the river trout population in 1983 demonstrates the potential severity of this existing pollution problem.

To help slow the further deterioration of water quality, thus protecting the existing salmonid fishery, all flow in Reach #1 and its major tributaries (Bridger, Rocky and Sourdough Creeks) should remain instream to dilute the various pollutants entering the river at Bozeman, as well as the effluent discharged at the sewage treatment facility. At the downstream boundary of Reach #1 this flow equals, during an average water year, about 87,817 acre-feet (121.3 cfs).

STREAM NAME: East Gallatin River

STREAM REACH: #2. From the Bozeman Sewage Treatment Plant Outlet to the confluence of Thompson Spring Creek - 13.7 miles

LOCATION: Sec. 26, T1S, R5E to Sec. 13, T1N, R4E

DESCRIPTION OF STREAM REACH:

The East Gallatin River in Reach #2 meanders through the Gallatin valley. Gradient averages 15.6 ft per mile and the sinuosity is 1.94. The river has a riffle-pool sequence, with pools ranging up to 8 ft in depth. The bottom substrate is primarily cobble-gravel, with silt deposits in the pools. The bank vegetation along portions of this reach has been removed, leaving eroded banks. Rock riprap is also common.

The destruction of bank and flood plain vegetation and the resulting loss of fish cover and increase in soil erosion is also a major concern in Reach #2. Another concern is water quality. Before the present sewage treatment plant at Bozeman was upgraded in 1971, water quality within Reach #2 was severely affected by sewage effluent. Vincent (1967) showed that salmonid reproduction within this reach was poor, probably a result of poor water quality. Since 1971, the facility has been upgraded further. The present plant now provides both secondary and tertiary treatment, the latter instituted primarily to control ammonia - a substance toxic to fish and other aquatic organisms.

From October, 1951 through December, 1953 the USGS operated a flow gage on the East Gallatin River at river mile 26. Mean monthly flows ranged from 36.7 cfs (in February, 1953) to 696 cfs (in May, 1952). The mean annual flow for the 1952 and 1953 water years was 137.4 cfs.

GAME FISH PRESENT: Rainbow trout, brown trout, mountain whitefish, brook trout.

FISHERY:

The rainbow trout is the predominant game fish in Reach #2, comprising about 75% of the total trout numbers. During electrofishing surveys, rainbow trout as large as 5 pounds have been captured, but few exceed 2 pounds. Brown trout, the other common trout species, typically reach weights of 2 pounds, with fish up to 9 pounds captured in recent years during the Department's annual electrofishing surveys.

Fish study sections were established in Reach #2 to monitor the effect of sewage effluents on the wild trout populations. Figure 2-146 shows the variations in trout populations in the Hoffman Ranch section since 1973. Population increases through 1982 were attributed to improved water quality that resulted from upgrades in the Bozeman sewage treatment facility. The cause of the population crash of rainbow trout in 1983 is unknown, although a point pollution source at Bozeman is suspected.

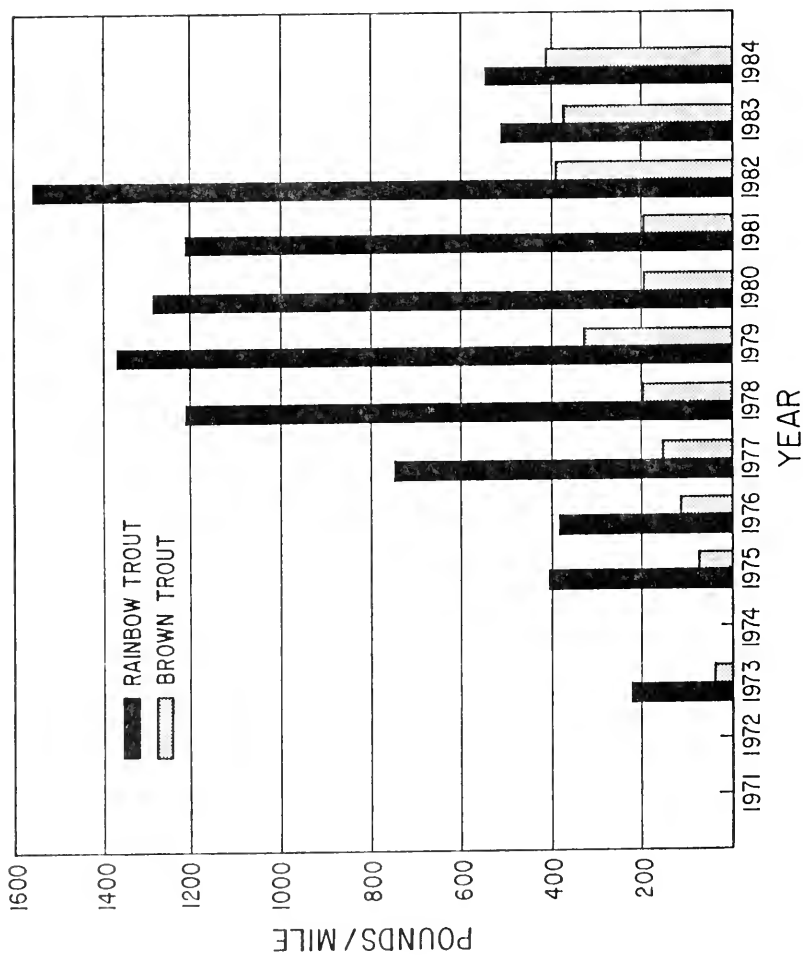


Figure 2-146. Comparison of fall estimates of biomass (pounds/mile) of adult trout in the Hoffman Ranch section of the East Gallatin River (from Vincent, 1985).

The population peaked in fall, 1982 when the study section supported an estimated 5,380 age one and older trout weighing 2,210 pounds, per mile of stream. This is a substantial population for a river the size of the East Gallatin.

WILDLIFE:

Big game animals found within the river floodplain are mule deer, white-tailed deer and an occasional black bear. Upland game birds include ruffed, grouse, Hungarian partridge and ring-necked pheasant. Mink, beaver, muskrat, red fox and raccoon are associated with the river and its riparian area.

Waterfowl use the river extensively during spring and fall migrations. Nesting waterfowl include mallard, blue-winged teal and common merganser. Mergansers and goldeneyes are common winter residents.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of Reach #2 at about river mile 23 (T1N, R5E, Sec. 29). Five cross-sections were established in this section. The WETP program was calibrated to field data collected at flows from 68.3 and 234.4 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section is shown in Figure 2-147. Lower and upper inflection points occur at approximate flows of 50 and 90 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 90 cfs (65,157 A.F./yr)

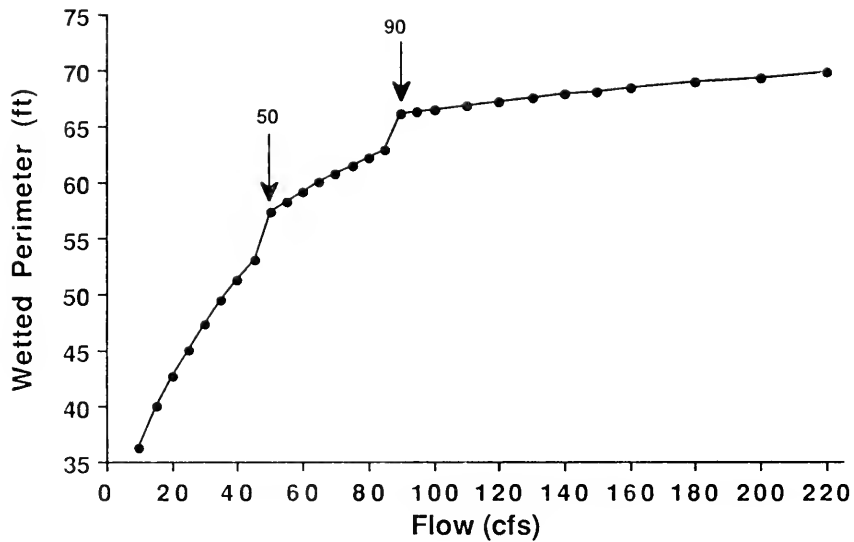


Figure 2-147. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #2 of the East Gallatin River.

STREAM NAME: East Gallatin River

STREAM REACH: #3. From the confluence of Thompson Spring Creek to the mouth - 18.6 miles

LOCATION: Sec. 13, T1N, R4E to Sec. 27, T2N, R3E

DESCRIPTION OF STREAM REACH:

The river in Reach #3 meanders through the lower Gallatin Valley. The river has a riffle-pool sequence, with pools ranging up to 10 ft in depth. Gradient averages 10.7 ft per mile and sinuosity is 1.67. Silt is a major component of the river bottom. The vegetation along the river bank consists of grasses, cottonwood, willow, alder, buffaloberry and various shrubs.

The primary environmental concern in Reach #3 is the destruction of bank vegetation. The removal of overhanging vegetation results in the loss of trout cover and increases bank erosion. Bank erosion is contributing to the high water turbidities and excessive sedimentation that characterize Reach #3. Bottom sediments decrease the numbers and kinds of trout food organisms, fill in trout habitat, and drastically reduce the survival of trout eggs.

Flow data for Reach #3 is extremely limited. The SCS estimated the mean annual flow for the East Gallatin River at its mouth at about 265 cfs.

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish, brook trout.

FISHERY:

The brown trout is the predominant sport fish in Reach #3, followed by rainbow trout, mountain whitefish and a few brook trout. Brown and rainbow trout occasionally reach weights up to 4-5 pounds, but few exceed 2 pounds.

In September, 1972 the estimated number of 2-year and older (about 10 inches and longer) trout in a study section within Reach #3 was about 909 per mile, weighing a total of 724 pounds (Vincent 1976). The trout fishery, while not of "Blue Ribbon" status, is popular with local fishermen.

WILDLIFE:

Big game animals found within the floodplain are mule deer, white-tailed deer and an occasional black bear. Upland game birds inhabiting the riparian area include ruffed grouse, Hungarian partridge and ring-necked pheasant. Mink, beaver, muskrat, otter, red fox and raccoon are associated with the river and its riparian zone.

Waterfowl use the river extensively during spring and fall migrations. Canada geese nest along the lower river within Reach #3. Other nesting waterfowl include mallard, blue-winged teal and common merganser. Mergansers and goldeneyes are common winter residents.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of Reach #3 located near the confluence of Story Creek at about river mile 11. Five cross-sections were established in a riffle-pool sequence. The WETP program was calibrated to field data collected at flows from 199 to 337 cfs.

The relationship between wetted perimeter and flow for the single riffle cross-section is shown in Figure 2-148. A prominent upper inflection point occurs at an approximate flow of 170 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the river and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 170 cfs (123,074 A.F./yr)

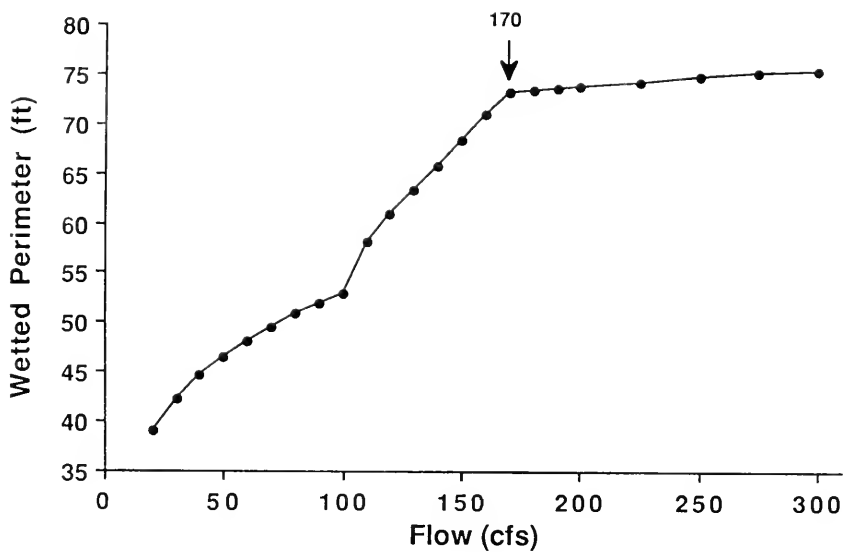


Figure 2-148. The relationship between wetted perimeter and flow for a single riffle cross-section in Reach #3 of the East Gallatin River.

UPPER MISSOURI RIVER SUB-BASIN
(CONFLUENCE OF JEFFERSON AND MADISON
RIVERS - CANYON FERRY DAM)

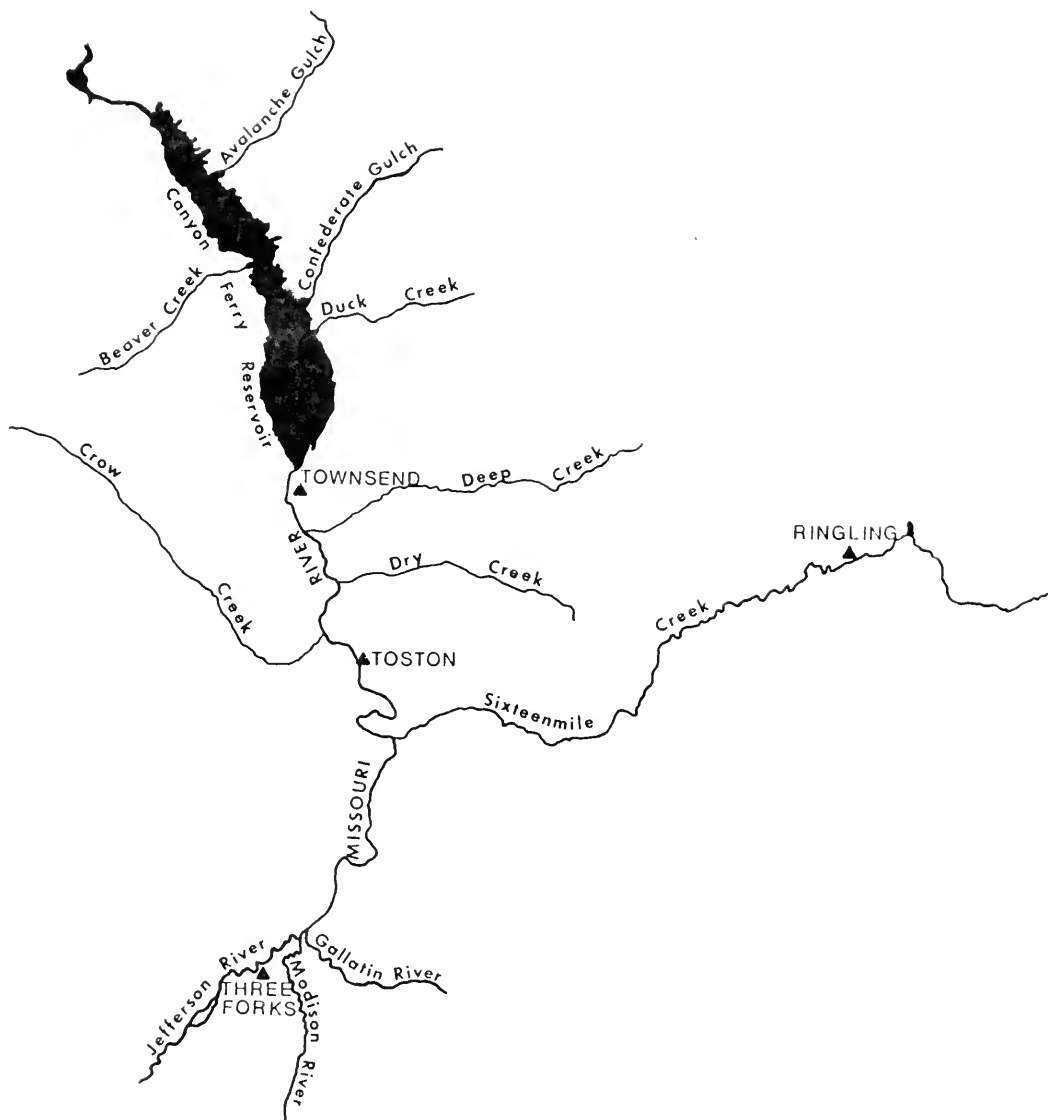


Figure 2-149. Map of the Upper Missouri River Sub-Basin (confluence of Jefferson and Madison rivers - Canyon Ferry Dam).

STREAM NAME: Missouri River

STREAM REACH: #1. From the convergence of the Jefferson and Madison Rivers to Canyon Ferry Reservoir - 43 miles

LOCATION: Sec. 17, T2N, R2E to Sec. 19, T7N, R2E

DESCRIPTION OF STREAM REACH:

Reach #1 of the Missouri River extends from the river's origin at the convergence of the Madison and Jefferson Rivers to Canyon Ferry Reservoir, a distance of 43 miles. This reach includes the 21 miles of "Blue Ribbon" water below Toston Dam. Toston Dam, which is a barrier to fish movement, creates a small, run-of-the-river irrigation storage reservoir that is presently being retrofitted for hydro-power generation.

Reach #1 drains an area of about 14,669 square miles (at Toston). Width of the channel ranges from 300 to 1,200 ft. The average gradient is 5.6 ft per mile and sinuosity is 1.6. Bottom substrate ranges from sand-silt to cobble, but the majority is gravel-cobble. Riparian vegetation is limited to a narrow band along the river, except for the lower 10 miles above Canyon Ferry Reservoir where the river channel is braided and the bottomland is extensively vegetated with willows and cottonwoods.

Tributaries entering Reach #1 originate mainly from the east and most are totally diverted during late summer for irrigation. Major tributaries are Deep, Dry, Sixmile, Indian, Crow, Sixteenmile and Greyson Creeks.

Reach #1 has good access for the recreationist. Public access points are especially well placed for floaters. These points include the Headwaters State Park at Three Forks and the Fairweather, Toston, Deepdale and Townsend Fishing Access sites. Floating is popular during the fall when excellent fishing for salmonids occurs, as well as good waterfowl hunting.

The USGS has operated a gage on the Missouri River below Toston Dam since 1910. The average annual flow for a 44-year period of record was 5,363 cfs. Mean monthly flows ranged from 2,840 cfs (for August) to 13,200 cfs (for June). Base winter flow was 3,360 cfs. Water to irrigate about 555,400 acres is diverted above this site. Thus, flow can be severely depleted during the summer irrigation season. Flows in this reach are partially regulated by a number of upstream reservoirs, including Hebgen Reservoir on the Madison River, Ruby Reservoir on the Ruby River and Clark Canyon Reservoir on the Beaverhead River.

GAME FISH PRESENT: Brown trout, rainbow trout, mountain whitefish.

FISHERY:

The 21-mile-long "Blue Ribbon" stretch of Reach #1 below Toston Dam is nationally known for producing trophy-size rainbow and brown trout in spring and fall, respectively, when trout from Canyon Ferry Reservoir ascend the Missouri River to spawn. From late August through November, brown trout in the 17-22 inch class are commonly caught by anglers, with fish of 6-10 pounds

taken annually. Fish in the spring rainbow run are generally smaller, averaging about 17 inches and 2 pounds.

Canyon Ferry Reservoir, which covers 35,180 acres, has historically been the most heavily fished body of water in Montana, with 79,205 fisherman-days of pressure estimated from May, 1983 - April, 1984. The reservoir brown trout fishery is wholly maintained by the natural reproduction that occurs in the Missouri River and other reservoir tributaries, while the rainbow trout population has, in the past, been maintained by plants of domesticated strains of hatchery fish. In spite of heavy annual plants, the reservoir rainbow fishery collapsed in the early 1980's. In an attempt to stabilize the fishery, the MDFWP began introducing, in 1983, wild strains of rainbow trout. Unlike the domesticated strain relied upon in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The success or failure of this continuing wild trout planting program will not become known for a few more years. Present results are encouraging, with wild spawners showing up in a number of tributaries, including the Missouri River, where the magnitude of the spawning run is increasing each spring.

While the sport fishermen in Reach #1 (below Toston Dam) mainly target the spring and fall spawning runs, resident trout are also available. The resident brown trout population, while not great in numbers, is characterized by the presence of larger-size fish. A Spring, 1982 population estimate showed that a mile of river supported about 143 age III and older (about 13 inches and longer) brown trout, weighing a total of 231 pounds. Other resident fish found below Toston Dam and their relative abundance are:

Cutthroat trout	rare
Brook trout	rare
Yellow perch	rare
Flathead chub	rare
Longnose dace	rare
Carp	abundant
White sucker	abundant
Longnose sucker	abundant
Stonecat	common
Rainbow trout	common
Mountain whitefish	common

The 22 miles of Reach #1 above Toston Dam are not accessible to spawning trout from the reservoir. Here, a resident population estimate in Spring, 1981 showed 237 age III and older (about 13 inches and longer) brown and rainbow trout, weighing 253 pounds, per river mile. Brown trout predominated, comprising 63% of the estimated trout numbers and 70% of the biomass.

Fish populations in Reach #1 are impacted by the severe dewatering that can occur in summer. Higher summer flows, particularly in August, would greatly benefit resident trout populations.

WILDLIFE:

White-tailed deer and ring-necked pheasant are common inhabitants of the bottomland along Reach #1. Other wildlife of particular interest are golden and bald eagles (both resident and migratory), osprey (6 to 7 nesting pairs), great blue heron (two large rookeries), and tundra and trumpeter swans (migratory). Resident furbearers include beaver, mink, muskrat and river otter. Common predators are red fox, coyote and raccoon.

Waterfowl use Reach #1 during fall and spring migrations. That portion of the river just above Canyon Ferry Reservoir harbors extensive numbers of nesting ducks and Canada geese. River islands are extensively used for nesting by Canada Geese.

WETTED PERIMETER:

Cross-sectional measurements in Reach #1 were made in Sec. 16C, T5N, R2E. The WETP program was calibrated to field data collected at flows of 1,680, 4,220 and 6,470 cfs.

The wetted perimeter-flow relationship for the composite of two riffle cross-sections (Figure 2-150) shows a prominent inflection point at a flow of 2,400 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain side channel spawning, incubation and rearing habitats for adult brown and rainbow trout residing in Canyon Ferry Reservoir; to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2,400 cfs (1,737,520 A.F./yr)

Research studies conducted by the MDFWP in 1980-81 indicated that trout, particularly brown trout, preferred side channels of the Missouri River, rather than the main channel, for spawning (Berg, 1981). The preference for side channels was apparently related to the presence of more suitable depth, velocity, substrate and adjacent cover characteristics.

In 1980 brown trout initiated spawning in side channels of the Missouri River in about mid-October. Spawning peaked in early November, and the incubation period for brown trout eggs extended through early May, when the emergence of young trout from the spawning gravel was completed. Rainbow trout spawned in side channels in late March and early April and some eggs incubated until mid-May. Based on these considerations, adequate flow must be maintained in side channels for trout spawning and incubation from mid-October through mid-May.

Berg's studies further indicated that Missouri River side channels are vital for the rearing of young-of-the-year (YOY) rainbow and brown trout through about mid-October, when large numbers of YOY began moving from the side channels to the main river channel.

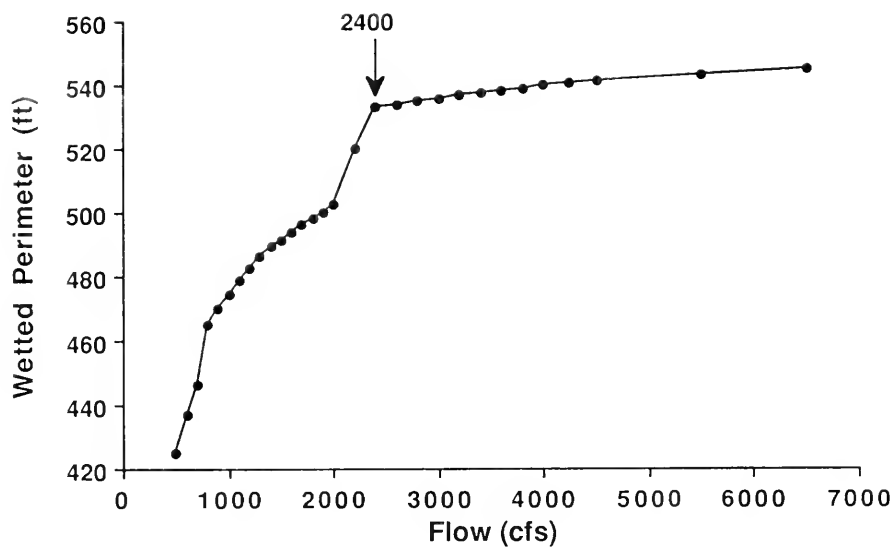


Figure 2-150. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Reach #1 of the Missouri River.

In summary, field studies indicated that side channels were vital year-round for trout spawning, the incubation of trout eggs, and the rearing of young.

In 1987 eight side channels of the Missouri River between Toston Dam and Canyon Ferry Reservoir were visited and photographed at a number of different flows between 1,440 and 2,990 cfs to visually assess flow conditions. Based on this assessment, it was determined that a flow of around 2,500 cfs was sufficient to almost totally wet the bottom of most side channels. Lesser flows accelerated the dewatering of shoreline gravel and cobble, exposing vast areas of bottom substrate as flows declined. A flow of about 2,500 cfs, therefore, was judged adequate to protect the trout producing capacity of side channels. Thus, the 2,400 cfs recommendation that was derived from the wetted perimeter inflection point method is sufficient to maintain the important spawning, incubation and rearing habitats provided by side channels.

STREAM NAME: Sixteenmile Creek

STREAM REACH: From the confluence of Billy Creek to the mouth - 66.5 miles

LOCATION: Sec. 32, T6N, R9E to Sec. 18, T4N, R3E

DESCRIPTION OF STREAM REACH:

Sixteenmile Creek originates in the foothills of the Crazy Mountains in southwest Montana at an elevation of approximately 6,000 ft. From its headwaters, it flows southwesterly for about 72 miles before joining the Missouri River 4 miles upstream from Toston Dam. The average gradient is 37 ft per mile. Near its mouth, the creek averages about 35 ft in width.

The landscape of Sixteenmile Creek consists of timbered foothills and sagebrush-grassland hills along the upper stream, and willow stands and hay fields alternating with steep, limestone canyons along the middle and lower stretches. Agriculture in the area consists primarily of cattle ranching with associated hay crops and some grain farming.

Several small irrigation reservoirs are located in the headwaters. In addition, water is pumped from Sixteenmile Creek to sprinkler irrigate hay fields along its middle stretch near Francis. Dewatering has had a minimal effect on the lower and middle sections of Sixteenmile Creek. However, the upper stream can become completely dewatered in late summer.

Habitat on portions of Sixteenmile Creek has suffered due to man's activities. Along most of its length, cattle use of the bottomland has caused local streambank instability and may affect the vigor of streambank vegetation.

Except for areas heavily used by cattle, the upper half of Sixteenmile Creek from its headwaters to its Middle Fork has a relatively stable, meandering stream channel. Along the lower stream, channel stability and habitat have deteriorated due to mechanical straightening of the channel to accommodate the Milwaukee Railroad bed.

Sixteenmile Creek is relatively remote. Poor roads, together with rough terrain, make physical access difficult. Nearly all of Sixteenmile Creek flows through private lands. However, fishermen access with permission from the landowners is possible.

GAME FISH PRESENT: Rainbow trout, brown trout, brook trout, cutthroat trout.

FISHERY:

Sixteenmile Creek supports a diverse wild trout fishery. In its headwaters, brook trout predominate, while rainbow trout are most abundant in the middle stream and brown trout in the lower stretches. Other game fish present are mountain whitefish and what may be a pure strain of Missouri River (westslope) cutthroat trout. Non-game fish include mottled sculpin, longnose sucker and white sucker.

The middle stream supports a particularly outstanding trout fishery. In September, 1974, two study sections upstream and downstream from Francis were electrofished. The upper section supported an estimated 325 rainbow trout, weighing 143 pounds, and 91 brown trout, weighing 46 pounds, per 1,000 ft of stream. In the lower section, 302 rainbow trout, weighing 154 pounds, and 152 brown trout, weighing 78 pounds, were estimated per 1,000 ft. Total trout biomass estimates of 189 and 232 pounds per 1,000 ft are exceptional for the mountain tributary streams in the upper Missouri River basin.

Two sections of lower Sixteenmile Creek were also electrofished in September, 1974. The upper study section, located just below the confluence of the South Fork, supported an estimated 55 brown trout, weighing 32 pounds, and 79 rainbow trout, weighing 29 pounds, per 1,000 ft. The section 2 miles above the creek's mouth supported a total trout biomass of only 17 pounds per 1,000 ft.

Due to generally poor habitat conditions caused by extensive stream alterations, only a fraction of the potential aquatic productivity is being realized in lower Sixteenmile Creek. However, there is a large potential to improve the habitat and fishery of this stretch by allowing the channel to regain its natural length and stabilize.

WILDLIFE:

The Sixteenmile Creek drainage supports diverse populations of game animals and game birds as well as many furbearers and non-game species. Big game populations include elk, mule deer, white-tailed deer, pronghorn antelope, black bear and mountain lion. Resident upland game birds are sage grouse, sharp-tailed grouse, Hungarian partridge and ring-necked pheasant. Mountain grouse (blue, ruffed and spruce grouse) are also present. Furbearers found in the drainage include raccoon, beaver, muskrat, mink, weasel, martin, badger, wolverine, bobcat, lynx, red fox and coyote. Various raptors are also seasonal inhabitants, including the bald eagle, golden eagle, rough-legged hawk, Swainson's hawk, red-tailed hawk, osprey and sparrow hawk.

Sixteenmile Creek is located in the Pacific migratory bird flyway. Its drainage and the adjacent prairie pothole country play host to many species of waterfowl during spring and fall migrations. A smaller number of "local" waterfowl remain all year. The most common waterfowl species found include the mallard, pintail, gadwall, shoveler, teal, Canada goose and snow goose.

WETTED PERIMETER:

Cross-sectional measurements were made in a 281 ft section of Sixteenmile Creek near its mouth (Sec. 8C, T4N, R3E). The WETP program was calibrated to field data collected at flows of 20.9, 44.4, and 96.9 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections (Figure 2-151) shows lower and upper inflection points at approximate flows of 12 and 20 cfs, respectively.

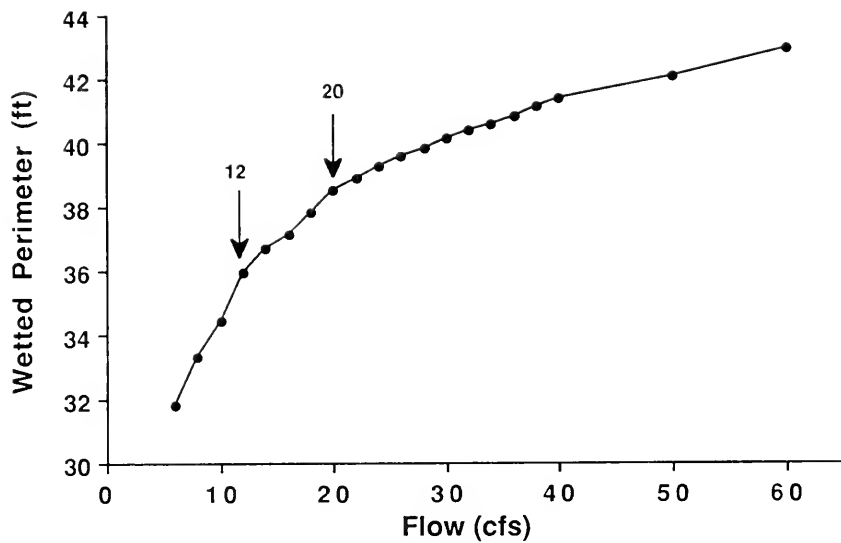


Figure 2-151. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Sixteenmile Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 20 cfs (14,479 A.F./yr)

STREAM NAME: Crow Creek

STREAM REACH: From the confluence of Tizer and Wilson Creeks to the Williams Ditch Intake - 11.5 miles

LOCATION: Sec. 23, T7N, R2W to Sec. 30, T6N, R1E

DESCRIPTION OF STREAM REACH:

Crow Creek begins at the confluence of Tizer and Wilson Creeks on the east slope of the Elkhorn Mountains (elevation 6,320 ft) and flows for 25.8 miles before joining the Missouri River near Toston, Montana. The stream gradient averages 93.5 feet per mile. Crow Creek averages 20.5 ft in width at low flow levels. It is free flowing for its entire length. Major tributaries to Crow Creek are South Fork, Tizer, Little Tizer, Moose, Clear and Crazy Creeks. The upper 40 percent of the stream is within the Helena National Forest.

Crow Creek is severely dewatered during the summer irrigation season soon after leaving public lands. Mining that is occurring in and near the stream channel and stream sedimentation resulting from overgrazing are other environmental concerns potentially affecting the aquatic resource.

The USGS operated a gage on Crow Creek at stream mile 16.7 for a 15-year period between 1919 and 1971. The mean annual flow for the period of record was 47.7 cfs. Mean monthly flows ranged from 8.4 cfs (for January and February) to 195 cfs (for June). This site is upstream from all irrigation diversions.

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout.

FISHERY:

A 1,000 ft section of Crow Creek within the Helena National Forest was electrofished on September 19 and October 16, 1980. Game fish captured in descending order of abundance were rainbow, brook and brown trout. The mottled sculpin was the only non-game species collected. The electrofishing survey data are summarized in Table 2-162.

Table 2-162. Summary of electrofishing survey data collected for a 1,000 ft section of Crow Creek (T6N, R1W, Sec. 23A) on September 19 and October 16, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	277	2.3 - 11.3
Brook trout	35	3.1 - 12.0
Brown trout	2	5.7 - 19.5
Mottled sculpin	-	-

The standing crop of rainbow trout, the predominant game species in the section, was estimated using a mark-recapture method (Table 2-163). This 1,000 ft section supported an estimated population of 409 rainbow trout (4.0 inches and longer), weighing 40 pounds. Populations of brook and brown trout were too sparse to estimate using the mark-recapture method.

Table 2-163. Estimated standing crop of rainbow trout in a 1,000 ft section of Crow Creek (T6N, R1W, Sec. 23A) on September 19, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.0 - 5.9	215	
	6.0 - 9.9	193	
	10.0 - 11.3	<u>1</u>	
		409(±52)	40(±4)

Crow Creek is the largest and most productive trout stream arising in the Elkhorn Mountains.

WILDLIFE:

Lands along lower Crow Creek from the Missouri River to just above Radersburg support a good population of white-tailed deer and are also one of the better local areas for hunting ring-necked pheasants. Mule deer replace white-tails near the Forest boundary. A major mule deer wintering area is just to the north in the Limestone Hills. The lower portion of the Crow Creek drainage within the Forest winters approximately 600 elk. These same elk summer along Crow Creek tributaries in the Tizer Basin. About 60 mountain goats inhabit the peaks and ridges forming the Tizer Basin.

Beaver occur throughout the drainage, but are mainly concentrated in the two major willow/riparian areas located below Radersburg and in the Tizer Basin. These same two areas provide some of the more important habitat for moose in hunting district 380.

WETTED PERIMETER:

Cross-sectional measurements were made in a 177 ft riffle-pool sequence located near the Forest boundary (T6N, R1W, Sec. 25B). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 21.7, 40.0 and 72.3 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 2-152. Lower and upper inflection points occur at approximate flows of 6 and 11 cfs, respectively.

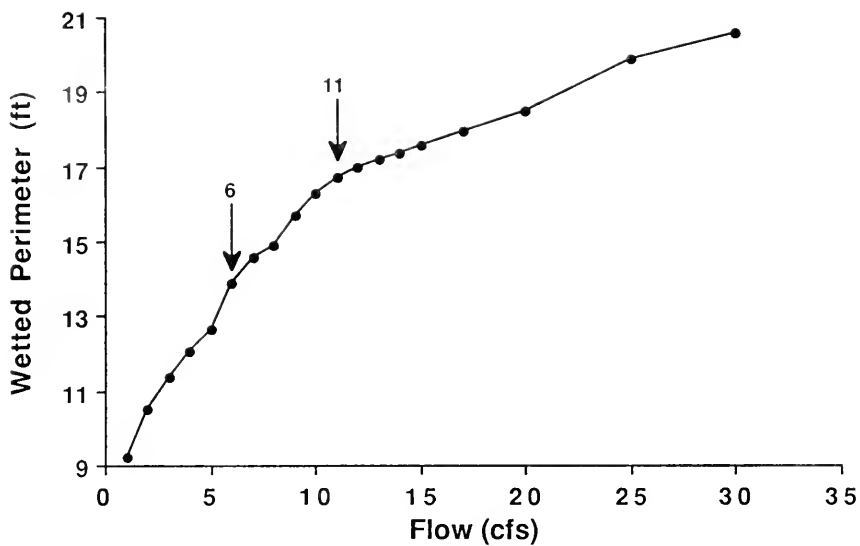


Figure 2-152. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Crow Creek.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 11 cfs (7,964 A.F./yr)

STREAM NAME: Dry Creek

STREAM REACH: From the headwaters to the Broadwater Missouri Canal-
15.6 miles

LOCATION: Sec. 1, T5N, R4E to Sec. 26, T6N, R2E

DESCRIPTION OF STREAM REACH:

Dry Creek originates in the Belt Mountains of southwest Montana and flows in a westerly direction for about 16.6 miles before entering the Missouri River south of Townsend. This small creek, which has a mean width of about 9.2 ft, primarily passes through open rangeland containing scattered stands of timber. About 4½ miles of stream are within the Helena National Forest, while the remainder is privately owned. Below the Forest, extensive bank erosion characterizes the stream morphology.

Livestock grazing is the primary land use within the upper drainage, while grain and hay production are dominant in the lower portion. Recreational access to the limited public lands within the drainage is good. Below the Forest, Dry Creek is extensively dewatered during the summer irrigation season.

GAME FISH PRESENT: Rainbow trout and rainbow x cutthroat hybrids, brook trout.

FISHERY:

A 1,000 ft section of Dry Creek at the Helena National Forest boundary was electrofished on April 10 and 24, 1981. Two hundred sixty-one rainbow and rainbow x cutthroat hybrid trout from 2.7-9.9 inches in length and 57 brook trout, ranging from 3.7-10.2 inches, were captured. The mottled sculpin was the only non-game species collected.

The standing crop of rainbow and rainbow x cutthroat hybrid trout in the section was estimated using a mark-recapture method (Table 2-164). This 1,000 ft section supported about 731 trout 4.0 inches and longer, weighing 60 pounds. The standing crop of brook trout could not be estimated due to the lack of a sufficient number of recaptures.

Dry Creek supports an exceptional biomass of trout for a mountain stream of its size. A network of beaver dams is responsible for the excellent trout habitat in this small stream.

Table 2-164. Estimated standing crop of rainbow and rainbow x cutthroat hybrid trout in a 1,000 ft section of Dry Creek (T6N, R4E, Sec. 30) on April 10, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow and rainbow x cutthroat hybrid trout	4.0 - 5.9	494	
	6.0 - 9.9	<u>237</u>	
		731(±180)	60(±12)

WILDLIFE:

Agricultural lands along lower Dry Creek support some white-tailed deer and ring-necked pheasants. Beaver inhabiting this stretch are quickly trapped out. The lower foothills where the Helena National Forest begins provide important winter range for mule deer and elk, while the heads of tributaries, both north and south of Dry Creek, provide important summer range for these animals. Beaver are periodically found within the Forest, but are trapped out easily. Other furbearers found along this stretch include mink, muskrat and coyote.

WETTED PERIMETER:

Cross-sectional measurements for Dry Creek were made in a stream section within the Helena National Forest (T6N, R4E, Sec. 30). The WETP program was calibrated to field data collected at flows of 4.5, 6.2 and 11.6 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections (Figure 2-153) shows lower and upper inflection points at about 1.2 and 1.8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 1.8 cfs (1,303 A.F./yr)

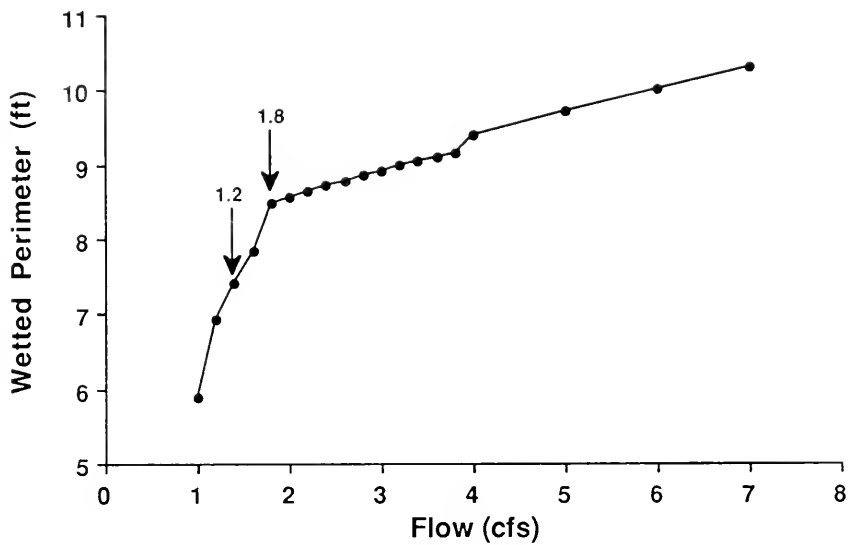


Figure 2-153. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Dry Creek.

STREAM NAME: Deep Creek

STREAM REACH: From the confluence of the Castle Fork to the Missouri River-
23.5 miles

LOCATION: Sec. 20, T7N, R5E to Sec. 8, T6N, R2E

DESCRIPTION OF STREAM REACH:

Deep Creek arises on the west slope of the Belt Mountains at an elevation of 6,520 feet and flows for about 29 miles to the Missouri River south of Townsend, Montana. The mean gradient is 94 ft per mile. The stream width at low flow averages about 23.5 ft. Major tributaries include North Fork Deep Creek, Cabin Gulch, Sulphur Bar Creek and the Russell Fork. About 7 miles of Deep Creek are within the Helena National Forest. Land surrounding the lower creek is privately owned and is used primarily for hay production. Recreational use of the Deep Creek drainage is mainly confined to fishing.

Deep Creek is dewatered immediately downstream from the National Forest boundary. Irrigation return flows and seepage from the Montana Ditch normally maintain year-round flow in the $\frac{1}{4}$ mile segment of stream below the ditch. The stream has had problems with flooding in the past and sections of Deep Creek have been severely altered as a result of highway construction.

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout.

FISHERY:

A 1,000 ft section of Deep Creek within the Helena National Forest was electrofished on September 17 and October 15, 1980. Game fish captured in descending order of abundance were rainbow, brook and brown trout. The mottled sculpin was the only non-game species collected. The electrofishing survey data are summarized in Table 2-165.

Table 2-165. Summary of electrofishing survey data collected for a 1,000 ft section of Deep Creek (T7N, R4E, Sec. 26C) on September 17 and October 15, 1980.

Fish Species	Number Captured	Length Range (inches)
Rainbow trout	202	2.1 - 13.0
Brook trout	24	4.6 - 8.9
Brown trout	24	3.1 - 15.5
Mottled sculpin	-	-

The standing crop of rainbow trout, the predominant game species in the section, was estimated using a mark-recapture method (Table 2-166). This

1,000 ft section supported an estimated population of 200 rainbow trout (4.0 inches and longer), weighing 25 pounds. Populations of brook and brown trout were too sparse to estimate using the mark-recapture method.

Table 2-166. Estimated standing crop of rainbow trout in a 1,000 ft section of Deep Creek (T7N, R4E, Sec. 26C) on September 17, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow trout	4.0 - 5.9	101	
	6.0 - 9.9	88	
	10.0 - 13.0	<u>11</u>	
		200(±20)	25(±2)

In 1983, the MDFWP began a program in Canyon Ferry Reservoir to improve the existing rainbow trout fishery by planting a wild stock of fish. These fish originate from eggs annually collected at Harrison Reservoir during the spring spawning run up Willow Creek. Unlike the domesticated hatchery strains relied upon in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of wild rainbow trout documented for a number of reservoir tributaries, including Deep Creek. Spawners have been captured during recent electrofishing surveys in the lower ¼ mile of stream below the Montana Ditch, which is a barrier to upstream migration.

WILDLIFE:

A low density beaver population, which is probably limited by excessive trapping pressure, occurs throughout the length of Deep Creek. Below the canyon, other resident furbearers include red fox, coyote and mink. Some white-tailed deer and a good population of ring-necked pheasants are also found along this lower section. Waterfowl use the lower creek and associated canals during late fall before freezing occurs.

The North Fork of Deep Creek provides important mule deer winter range. Most of the side drainages entering Deep Creek in the canyon provide important habitat for elk and mule deer during all seasons except winter.

WETTED PERIMETER:

Cross-sectional measurements were made in a 222 ft riffle-pool sequence located near the Forest boundary (T7N, R4E, Sec. 30C). Five cross-sections were established. The WETP program was calibrated to field data collected at flows of 18.0, 44.8 and 122.2 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 2-154. Lower and upper inflection points occur at approximate flows of 25 and 56 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning habitat for rainbow trout residing in Canyon Ferry Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 9 cfs (6,516 A.F./yr)

The upper inflection point flow for Deep Creek (56 cfs) is inordinately high when compared to the average annual flow, estimated at 27 cfs by the USGS. The portion of the Deep Creek channel containing the WETP cross-sections was "blown out," the probable result of excessively high flows from the North Fork of Deep Creek, a drainage that has been heavily logged in recent years. While the 56 cfs is needed to maintain riffle wetted perimeter, it is an unrealistic request when compared to water availability. The flow request was, therefore, derived using the fixed percentage method, an alternative method described in Volume 1 of this application. Under this method, 34% of the average annual flow is being requested for those upper Missouri River tributaries having high fishery values. An instream flow of 9 cfs is, therefore, requested for Deep Creek.

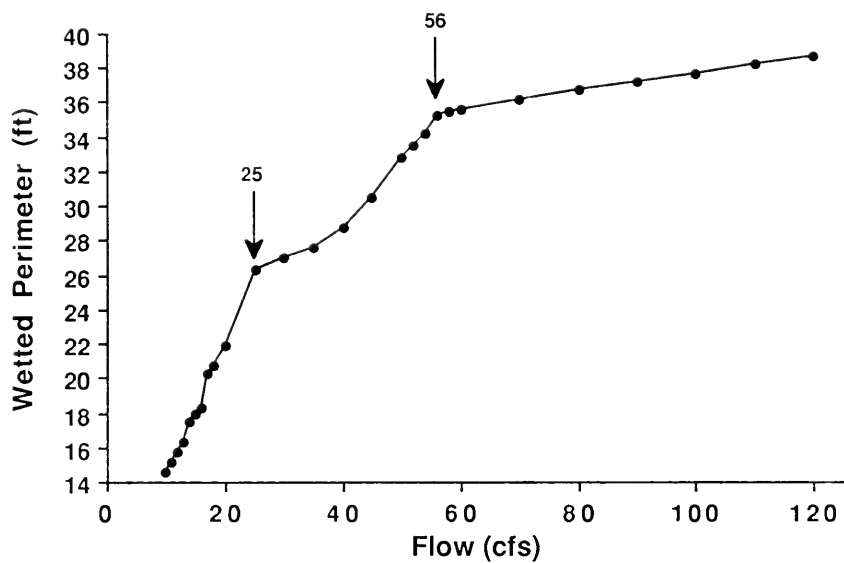


Figure 2-154. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Deep Creek.

STREAM NAME: Duck Creek

STREAM REACH: From the headwaters to Canyon Ferry Reservoir - 12.4 miles

LOCATION: Sec. 25, T9N, R3E to Sec. 8, T8N, R2E

DESCRIPTION OF STREAM REACH:

Duck Creek originates in the Belt Mountains of southwest Montana and flows for 12.4 miles before discharging into Canyon Ferry Reservoir. The upper stream is confined to a narrow valley surrounded by gently rolling mountains. After leaving the mountains, the stream passes through open, dry agricultural and grazing lands before entering the reservoir. The headwaters (about 1½ miles of stream) are within the Helena National Forest, while another 1½ miles pass through BLM parcels. The remainder is privately owned. At low flow, the stream width averages about 16.7 ft.

Duck Creek is dewatered in the summer once it reaches agricultural lands. Irrigation return flows help to recharge the stream upstream from the reservoir.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Duck Creek was electrofished on April 9 and 23, 1981. One hundred thirty-five brook trout from 2.6-9.8 inches in length and 14 rainbow trout, ranging from 4.7-7.5 inches, were captured. The mottled sculpin was the only non-game species present.

Standing crops of brook and rainbow trout in the section were estimated using a mark-recapture method (Table 2-167). This 1,000 ft section supported an estimated 210 trout, weighing 14 pounds.

Table 2-167. Estimated standing crops of trout in a 1,000 ft section of Duck Creek (T8N, R3E, Sec. 6) on April 9, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.0 - 5.9	142	
	6.0 - 9.8	52	
		194(±26)	12(±2)
Rainbow trout	4.7 - 5.9	8	
	6.0 - 7.5	8	
		16(±2)	2(±0)
Total trout		210(±26)	14(±2)

In 1983, the MDFWP began a program to improve the rainbow trout fishery in Canyon Ferry Reservoir by planting a wild stock of fish. Unlike the domesticated hatchery strains planted in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir fishery. A spring spawning run of wild rainbow trout has developed in Duck Creek in recent years. The magnitude of this run and the stream's contribution of young recruits to the reservoir fishery have not been quantified as yet.

WILDLIFE:

The well developed willow/hay bottoms along the lower few miles of Duck Creek provide habitat for a good population of white-tailed deer as well as ring-necked pheasants, mink and beaver. Canada geese nest along this stretch and use the outlet bay for brood rearing. Counts of 75-100 geese are common during the rearing period.

The lower foothills along Duck Creek below the Forest boundary provide winter range for a good number of mule deer. Approximately 150 elk winter in the vicinity of the Middle and North Forks of Duck Creek. Drainage heads provide summer range for these animals.

WETTED PERIMETER:

Cross-sectional measurements for Duck Creek were made in a BLM owned stream section in T8N, R3E, Sec. 6. The WETP program was calibrated to field data collected at flows of 9.6, 12.8 and 34.6 cfs.

The relationship between wetted perimeter and flow for a single riffle cross-section (Figure 2-155) shows lower and upper inflection points at about 4 and 8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning habitat for rainbow trout residing in Canyon Ferry Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 8 cfs (5,792 A.F./yr)

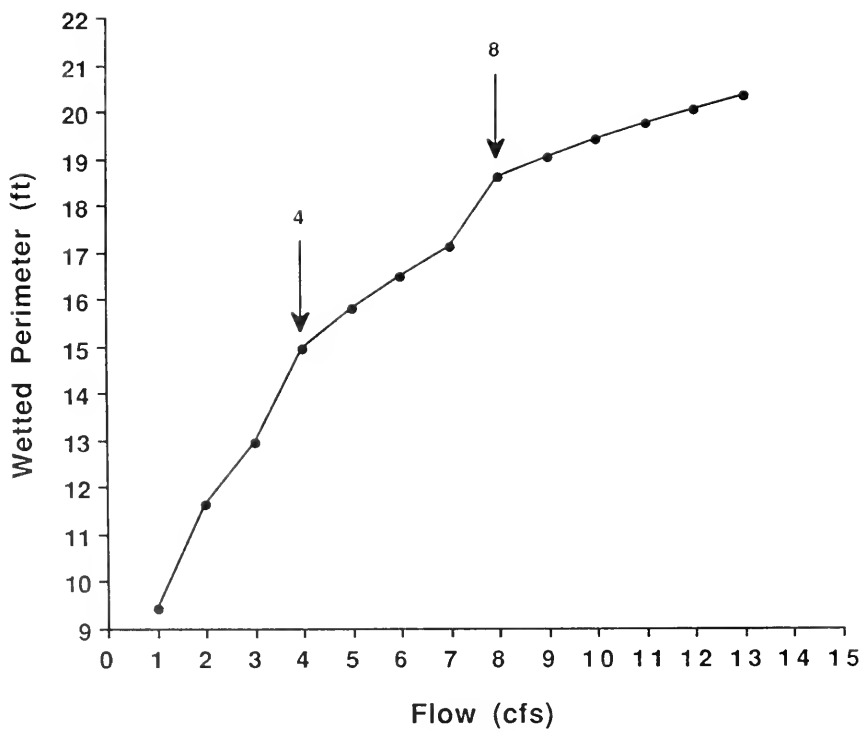


Figure 2-155. The relationship between wetted perimeter and flow for a single riffle cross-section in Duck Creek.

STREAM NAME: Confederate Gulch

STREAM REACH: From the confluence of Debauch Gulch to the mouth - 13.9 miles

LOCATION: Sec. 16, T10N, R3E to Sec. 32, T9N, R2E

DESCRIPTION OF STREAM REACH:

Confederate Gulch originates in the Belt Mountains of southwest Montana and flows in a southwesterly direction for 15.5 miles before discharging into Canyon Ferry Reservoir. The upper stream is confined to a narrow valley surrounded by gently rolling mountains. After leaving the mountains, the stream passes through open, dry agricultural and grazing lands before entering the reservoir. Much of the lower 9 miles of Confederate Gulch below Boulder Creek have been altered by road construction and past placer mining. Piled gravel and rock are a prominent feature of the floodplain in this area. The upper 60% of Confederate Gulch pass through public lands managed by the BLM and Forest Service. At low flow, the stream has a mean width of about 14.3 ft.

Confederate Gulch is totally dewatered during the summer irrigation season when it leaves the mountains about 5 miles above its mouth. In most years, groundwater recharge maintains year-round flow in the lower stream above Canyon Ferry Reservoir.

GAME FISH PRESENT: Brook trout, rainbow x cutthroat hybrid trout, rainbow trout, brown trout.

FISHERY:

A 1,000 ft section of Confederate Gulch near the Forest boundary was electrofished on April 9 and 23, 1981. Sixty-six brook trout, ranging from 3.4-11.1 inches, and 21 rainbow x cutthroat hybrid trout from 5.0-10.1 inches were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-168). This 1,000 ft section supported about 138 trout, weighing a total of 12 pounds. Brook trout predominated, comprising about 87% of the estimated trout numbers and 75% of the biomass.

Table 2-168. Estimated standing crop of trout in a 1,000 ft section of Confederate Gulch (T10N, R2E, Sec. 25) on April 9, 1981. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.5 - 5.9	92	
	6.0 - 9.9	21	
	10.0 - 11.1	7	
		120(±28)	9(±2)
Rainbow x cutthroat hybrid trout	5.5 - 5.9	3	
	6.0 - 9.9	14	
	10.0 - 10.1	1	
		18(±2)	3(±0)
Total trout		138(±28)	12(±2)

In 1983, the MDFWP began a program in Canyon Ferry Reservoir to improve the existing rainbow trout fishery by planting a wild stock of fish. These fish originate from eggs annually collected at Harrison Reservoir during the spring spawning run up Willow Creek. Unlike the domesticated hatchery strains planted in the past, these fish are capable of reproducing in the wild, thus contributing to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of wild rainbow trout documented for a number of reservoir tributaries, including Confederate Gulch. Impassable beaver dams limit the spawning run to the lower ½ mile of Confederate Gulch.

In addition, Confederate Gulch supports a fall spawning run of brown trout from the reservoir. This is the only reservoir tributary (other than the Missouri River) in which spawning use by brown trout has been documented.

WILDLIFE:

White-tailed deer are abundant in the well developed willow bottoms along the lower few miles of Confederate Gulch. Beaver and other furbearers are also present. Antelope and some mule deer inhabit the flats between Confederate Gulch and Avalanche Creek.

Furbearers are limited along the Forest Service and foothill sections of Confederate Gulch due to past mining disturbance and resulting lack of a riparian zone. When beaver do get established in this area, they are readily trapped out.

A wintering herd of approximately 300 elk is associated with the following tributaries to Confederate Gulch - Boulder, Spruce, Hinaman and

Clear Creeks. Drainage heads provide summer range for these elk. Mule deer occupy the same areas and, while not quantified, are abundant. A small band of mountain goats summers along the divide at the head of the drainage.

WETTED PERIMETER:

Cross-sectional measurements were made in a section of Confederate Gulch in Sec. 25, T10N, R2E. Four riffle cross-sections were established. The WETP program was calibrated to field data collected at flows of 3.9, 22.0 and 45.6 cfs.

The wetted perimeter-flow relationship for the composite of four riffle cross-sections (Figure 2-156) shows lower and upper inflection points at approximate flows of 2 and 5 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; to maintain spawning habitat for brown and rainbow trout residing in Canyon Ferry Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

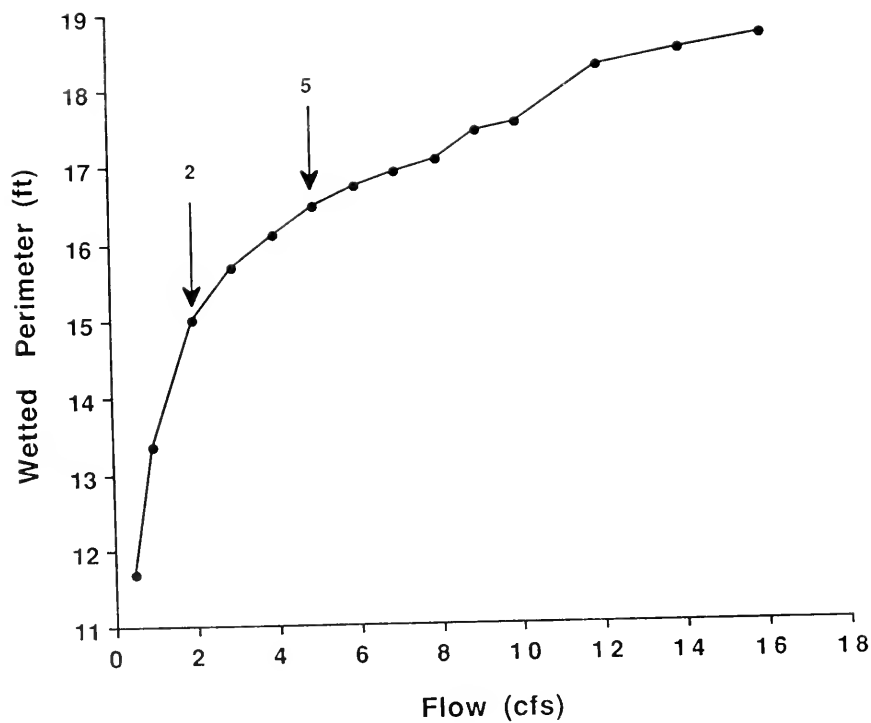


Figure 2-156. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Confederate Gulch.

STREAM NAME: Beaver Creek

STREAM REACH: From the headwaters to Canyon Ferry Reservoir - 14.1 miles

LOCATION: Sec. 26, T8N, R2W to Sec. 27, T9N, R1E

DESCRIPTION OF STREAM REACH:

Beaver Creek arises on the east slope of the Elkhorn Mountains near High Peak (elevation 8,534 ft) and flows east for 14.1 miles before discharging into Canyon Ferry Reservoir near Winston, Montana. The mean gradient of Beaver Creek is 252 feet per mile. At low flow, the stream averages 21.2 feet in width. Major tributaries include South Fork Beaver Creek, North Pole Creek and Sawmill Creek.

Recreational use of the area along Beaver Creek is limited to camping and fishing. The upper 36 percent of the stream is located within the Helena National Forest. Land surrounding the lower portion is privately owned and used mainly for livestock grazing. An existing environmental problem in the Beaver Creek drainage is the severe dewatering of the privately owned portion of the creek during the summer irrigation season.

Daily flow measurements collected by personnel of the Helena National Forest at a site upstream from all irrigation diversions are available for April-November, 1984-86. The lowest flows during the period of record occurred in September, when the monthly flow averaged 4.9 cfs. The lowest flow recorded was 3.1 cfs.

GAME FISH PRESENT: Brook trout, rainbow trout.

FISHERY:

A 1,000 ft section of Beaver Creek within BLM lands at about stream mile 9 was electrofished on September 18 and October 16, 1980. One hundred ninety-two brook trout, ranging from 3.7-8.9 inches in length, were captured. The mottled sculpin was the only non-game species present.

The standing crop of brook trout was estimated using a mark-recapture method (Table 2-169). This 1,000 ft section supported an estimated population of 458 brook trout (3.7 inches and longer), weighing 30 pounds. For a mountain stream of its size, Beaver Creek supports a fairly substantial brook trout population.

Table 2-169. Estimated standing crop of brook trout in a 1,000 ft section of Beaver Creek (T8N, R1W, Sec. 15D) on September 18, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Brook trout	3.7 - 5.9	332	
	6.0 - 8.9	<u>126</u>	
		458(±101)	30(±6)

In 1983, the MDFWP began a program in Canyon Ferry Reservoir to improve the existing rainbow trout fishery by planting a wild stock of fish. These fish originate from eggs annually collected at Harrison Reservoir during the spring spawning run up Willow Creek. Unlike the domesticated hatchery strains planted in the past, these fish are capable of reproducing in the wild and, thus, contribute to the maintenance of the reservoir sport fishery. The program to date has been successful, with spawning runs of wild rainbow trout documented for a number of reservoir tributaries, including Beaver Creek. Rainbow trout spawners have been captured in the lower ½ mile of Beaver Creek during recent electrofishing surveys.

WILDLIFE:

Lower Beaver Creek supports some beaver and mink. These populations, however, are probably limited by the stream dewatering that occurs during the summer irrigation season. Other furbearers along this section include coyote, red fox and bobcat. A good white-tailed deer population and some ruffed grouse are found in the well developed aspen/cottonwood bottoms and associated agricultural lands along this lower section.

As the Forest Service boundary is approached, white-tailed deer are replaced by a low density mule deer population. Furbearers are limited due to an increasing creek gradient and the lack of a well developed riparian zone. Sporadic use by moose along the lower section of the Forest has been observed in recent years. Elk winter on the open slopes along Sawmill Creek, a tributary to Beaver Creek. The head of the Beaver Creek drainage provides summer range for mountain goats, which are associated with the surrounding peaks, elk and mule deer.

During the spring, Canada geese use the bay where Beaver Creek enters the reservoir and, while not documented, some nesting is believed to occur in the area.

WETTED PERIMETER:

Cross-sectional measurements were made in a 233 ft cascading riffle area located near the Forest boundary (T8N, R1W, Sec. 15D). Five cross-sections

were established. The WETP program was calibrated to field data collected at flows of 5.3, 12.4 and 72.6 cfs.

The relationship between wetted perimeter and flow for the composite of five riffle cross-sections is shown in Figure 2-157. Lower and upper inflection points occur at approximate flows of 1.8 and 2.8 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout population; to help maintain spawning habitat for rainbow trout residing in Canyon Ferry Reservoir; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 2.8 cfs (2,027 A.F./yr)

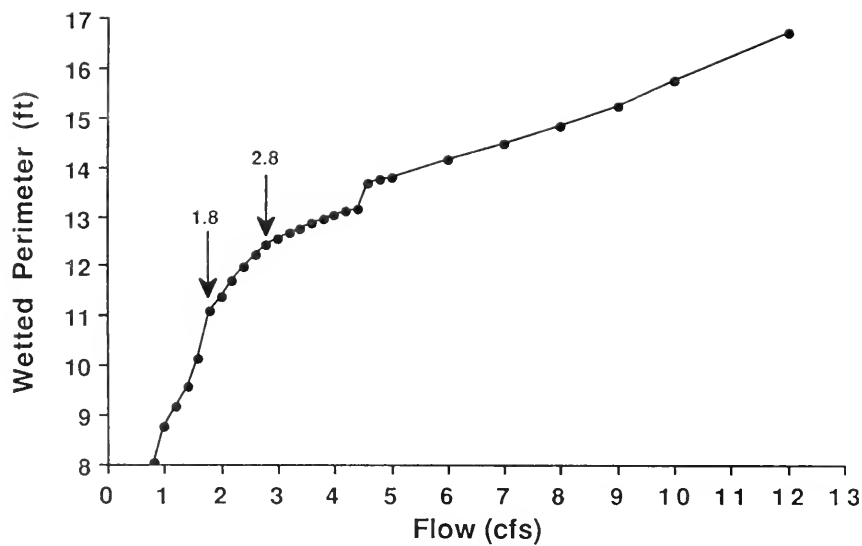


Figure 2-157. The relationship between wetted perimeter and flow for a composite of five riffle cross-sections in Beaver Creek.

STREAM NAME: Avalanche Creek

STREAM REACH: From the confluence of Cooney Gulch to Canyon Ferry Reservoir
- 15.1 miles

LOCATION: Sec. 6, T11N, R2E to Sec. 29, T10N, R1E

DESCRIPTION OF STREAM REACH:

Avalanche Creek arises on the west slope of the Belt Mountains in southwest Montana and flows in a southwesterly direction for about 16 miles before discharging into Canyon Ferry Reservoir. The headwater portion of the drainage consists of forested, rolling mountains having elevations of 7,000-8,000 ft. Upon leaving the mountains, the creek passes through a steep canyon before entering the open bench lands that characterize the lower drainage. Approximately 70 percent of the creek is located within the Helena National Forest. The mean gradient of the creek is 158 feet per mile. At low flow levels, stream width averages 9.3 ft. Major tributaries are Nary Time, Spilling and Shannon Gulches and Cayuse Creek.

Grazing of livestock occurs on the bench lands surrounding the lower creek and in the Forest. Past mining of the headwater area has been extensive. Below the Forest boundary, Avalanche Creek is severely dewatered during the summer irrigation season.

GAME FISH PRESENT: Rainbow x cutthroat hybrid trout.

FISHERY:

A 1,000 ft section of Avalanche Creek near the Forest Service boundary was electrofished on September 18 and October 15, 1980. One hundred ten rainbow x cutthroat hybrid trout, ranging from 3.8-10.6 inches in length, were captured. The mottled sculpin was the only non-game species present.

The standing crop of trout was estimated using a mark-recapture method (Table 2-170). This 1,000 ft section supported about 132 hybrid trout longer than 3.8 inches, weighing 13 pounds.

Table 2-170. Estimated standing crop of trout in a 1,000 ft section of Avalanche Creek (T10N, R1E, Sec. 11D) on September 18, 1980. Eighty percent confidence intervals are in parentheses.

Species	Length Group (inches)	Per 1,000 ft	
		Numbers	Pounds
Rainbow x cutthroat hybrids	3.8 - 5.9	75	
	6.0 - 9.9	55	
	10.0 - 10.6	2	
		132(±14)	13(±2)

WILDLIFE:

Antelope and some mule deer inhabit the flats surrounding lower Avalanche Creek. A major wintering area for mule deer that is associated with adjacent grain fields is located just outside the Helena National Forest boundary. Mountain goats are found at the mouth of the canyon during the winter. Approximately 120 elk winter on the divide between Avalanche and Whites Gulch. Drainage heads provide important summer range for elk, mule deer and a small number of mountain goats. Canada geese use Avalanche Bay in the spring and fall, feeding in nearby grain fields.

WETTED PERIMETER:

Cross-sectional measurements were made in a 168 ft riffle-run sequence located 1.5 miles above the Forest boundary (T10N, R1E, Sec. 11D). Five cross-sections were placed in this sequence. The WETP program was calibrated to field data collected at flows of 6.2, 10.7 and 13.3 cfs.

The relationship between wetted perimeter and flow for the composite of two riffle cross-sections is shown in Figure 2-158. Lower and upper inflection points occur at approximate flows of 3.0 and 5.0 cfs, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain the existing resident trout populations; and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1-December 31 -- 5 cfs (3,620 A.F./yr)

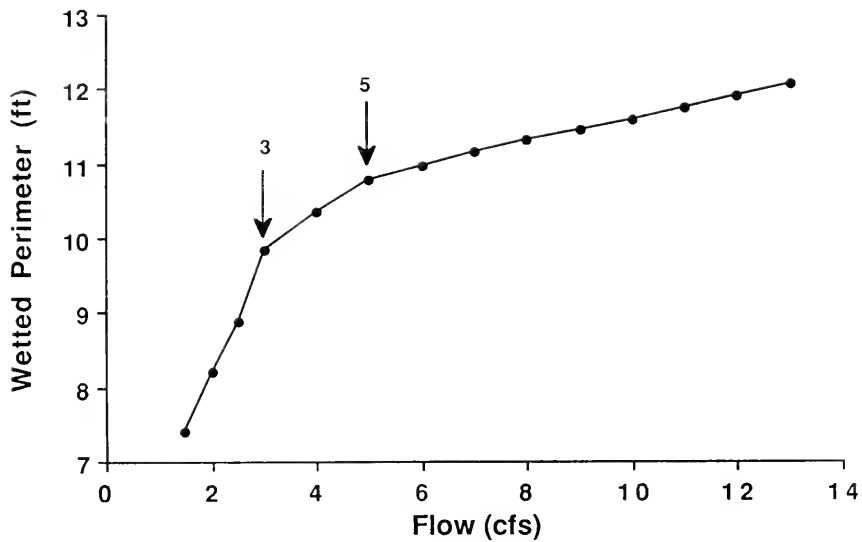


Figure 2-158. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in Avalanche Creek.

REFERENCES

- Behnke, R. J. 1979. The native trouts of the genus Salmo of western North America. Monograph, U.S.F.S., U.S. Fish and Wildlife Service and BLM. 163 pp.
- Berg, R. K. 1981. Middle Missouri River planning project. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. FW-3-R-9, Job 1-a. 39 pp.
- Blue Ribbons of the Big Sky Country Areawide Planning Organization. 1978. Draft final report and water quality management plan, February, 1978. 158 pp.
- Brown, C. J. D. 1971. Fishes of Montana. Big Sky Books, Montana State University, Bozeman.
- Bureau of Land Management. 1980. Mountain foothills grazing management program. Draft EIS, Department of Interior, BLM, Butte District Office, Montana. 308 pp.
- Elser, A. A. and R. G. Marcoux. 1972. Inventory of waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-19, Job 1-a. 38 pp.
- Farnes, P. E. and B. A. Shafer. 1972. Hydrology of Gallatin River drainage. USDA, Soil Conservation Service, Montana. 29 pp.
- Farnes, P. E. and B. A. Shafer. 1975. Hydrology of Jefferson River drainage. USDA, Soil Conservation Service, Bozeman, Montana. 43 pp.
- Foggin, G. T., T. D. Reid and S. J. Gilbert. 1978. Dillon resource area resources inventory: water quality survey. Montana Forest and Conservation Experiment Station, Missoula. Five volumes.
- Gardner, W. M. 1977. The effects of heavy metals on the distribution and abundance of aquatic insects in the Boulder River, Montana. M.S. Thesis, Montana State University, Bozeman. 84 pp.
- Gardner, W. M. and R. K. Berg. 1981. An analysis of the instream flow requirements for selected fishes in the Wild and Scenic portion of the Missouri River. Montana Department of Fish, Wildlife and Parks, Helena. 111 pp.
- Greene, J. W., R. L. Chatriand, P. T. Sawyer and E. E. Gless. 1971. Invertebrate sampling of the Ruby River. Madison County, Montana. A report to Montana Bureau of Mines and Geology. 18 pp.
- Haugen, G. 1975. Summary of 1974 stream surveys in 30 select streams on the Beaverhead National Forest. Northern Region USFS. 27 pp.

- Haugen, G. 1977. Ruby River fishery habitat and range resource evaluation. Summary Report #1, Beaverhead National Forest, Bozeman, Montana. 39 pp.
- Heaton, J. R. 1960. Inventory of waters of the project area--Big Hole River drainage survey. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-8, Job I. 14 pp.
- Henshall, J. A. 1907. Culture of the Montana grayling. Bureau of Fish, Doc. No. 628. 7 pp.
- Horpestad, A. 1976. Hebgen Lake water quality study on the Gallatin National Forest. Water Quality Bureau, Montana Department of Health and Environmental Sciences, Helena.
- Kozakiewicz, V. J. 1979. The trout fishery of the lower Big Hole River, Montana, during 1977 and 1978. M.S. Thesis, Montana State University, Bozeman. 74 pp.
- Liknes, G. A. 1981. The fluvial arctic grayling (Thymallus arcticus) of the upper Big Hole River drainage, Montana. M.S. Thesis, Montana State University, Bozeman. 59 pp.
- Lisle, T. E. 1972. Sediment yield and hydrodynamic implications, West Fork of the Madison River, Montana. M.S. Thesis, University of Montana, Missoula.
- Logan, L. D. 1973. Squaw Creek watershed and debris situation analysis with alternatives. Gallatin National Forest, Bozeman.
- Lund, J. A. 1974. The reproduction of salmonids in the inlets of Elk Lake, Montana. M.S. Thesis, Montana State University, Bozeman. 43 pp.
- Lyden, C. J. 1948. The gold placers of Montana. Memoir #26, State of Montana, Bureau of Mines, Butte. 152. pp.
- Matney, C. E. and W. H. Garvin. 1978. Agricultural water quality in the Gallatin and Madison drainages. Blue Ribbons of the Big Sky Country Areawide Planning Organization, Bozeman, Montana. 139 pp.
- Montana Department of Fish, Wildlife and Parks. 1984. Estimated man-days of fishing pressure by region for the summer and winter seasons, May 1983-April 1984. MDFWP, Helena.
- Myers, L. H. 1976. Woody riparian survey. Unpublished, BLM, Dillon Resource Area, Montana. 15 pp.
- Nelson, F. A. 1976. The effects of metals on trout populations in the upper Boulder River, Montana. M.S. Thesis, Montana State University, Bozeman. 60 pp.
- Nelson, F. A. 1977. Beaverhead River and Clark Canyon Reservoir fishery study. Montana Department of Fish, Wildlife and Parks, Helena. 118 pp.

- Nelson, P. H. 1954. Life history and management of the American grayling (Thymallus signifer tricolor) in Montana. Journal of Wildlife Management 18(3):324-347.
- Oswald, R. A. 1981. Aquatic resources inventory of the Mount Haggin area. Montana Department of Fish, Wildlife and Parks, Helena. 89 pp.
- Page, W. L. 1978. Sediment yields from rangelands in the upper Ruby River drainage, Southwestern Montana. M.S. Thesis, University of Montana, Missoula. 73 pp.
- Peterson, N. W. 1972. Elk Lake-Narrows Creek Study, July 1, 1971-June 30, 1972. Montana Fish and Game Report in Cooperation with U.S. Forest Service, Job Progress Report. 19 pp.
- Peterson, N. W. 1973. Inventory of the waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-20, Job I-b. 11 pp.
- Peterson, N. W. 1974. Inventory of waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-21, Job I-a. 12 pp.
- Peterson, N. W. 1974. Inventory of waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-22, Job I-b. 13 pp.
- Peterson, N. W. 1975. Inventory of the waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-23, Job I-b. 17 pp.
- Peterson, N. W. 1976. Inventory of waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-24, Job I-b. 12 pp.
- Peterson, N. W. 1979. Inventory of the waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-25, Job I-b. 23 pp.
- Pierce, B. E. 1966. Distribution of fish in a small Montana stream in relation to temperature. Proc. Montana Acad. Sci. 26:22-32.
- Randall, L. 1978. Red Rock Lakes National Wilderness--an aquatic history 1899-1977. U.S. Department of the Interior, USFWS. 244 pp.
- Rehwinkel, B. and E. R. Vincent. 1982. Southwest Montana fisheries study, inventory and survey of the water of Gallatin and Madison drainages. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-29, Job No. I-a. 11 pp.
- Roscoe, J. W. 1974. Systematics of the westslope cutthroat trout. M.S. Thesis, Colorado State University, Ft. Collins. 74 pp.

- Schrader, W. C. 1988. Winter habitat requirements of rainbow trout in a small Montana stream. M.S. Thesis, Montana State University, Bozeman.
- Snyder, G., J. Black, P. Swetik and H. F. Haupt. 1978. Modeling forest water quality of the Upper Gallatin-Madison watersheds using the benchmark system. Blue Ribbons of the Big Sky Country Areawide Planning Organization, Bozeman, Montana. 181 pp.
- Soil Conservation Service. 1976. Hydrology of Madison River drainage. Soil Conservation Service, Bozeman, Montana. 31 pp.
- State Engineers Office. 1953. Water resources survey. Part 1: History of land and water use on irrigated areas, Gallatin County, Montana. 61 pp.
- U.S. Fish and Wildlife Service. 1952. Creel census and expenditure study, Madison River, Montana. Special Scientific Report No. 126. 39 pp.
- U.S. Fish and Wildlife Service. 1956. East Bench Unit Montana, a detailed report on fish and wildlife resources. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of River Basin Studies, Billings, Montana. 49 pp.
- U.S. Forest Service. 1973. Gallatin National Forest multiple use plan, Part II. Porcupine-Buffalo Horn planning unit (Draft Copy). 51 pp.
- Vincent, E. R. 1967. Evaluation of river fish populations. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-15, Job VII.
- Vincent, E. R. 1968. Evaluation of river fish populations. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-16, Job VII.
- Vincent, E. R. 1971. Evaluation of river fish populations. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-19, Job No. III-a. 19 pp.
- Vincent, E. R. 1973. Evaluation of river fish populations. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-20, Job No. III-a. 17 pp.
- Vincent, E. R. 1975. Inventory of waters of the project area. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-23, Job No. I-a. 12 pp.
- Vincent, E. R. 1976. Inventory and survey of the waters of the project area. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-24, Job No. I-a.
- Vincent, E. R. 1979. Madison River-West Gallatin River, trout harvest study. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-27, Job No. II-b. 16 pp.

- Vincent, E. R. 1987. Effects of stocking catchable-size hatchery rainbow trout on two wild trout species in the Madison River and O'Dell Creek, Montana. North American Journal of Fisheries Management 7:91-105.
- Vincent, E. R. and C. Clancy. 1980. Southwest Montana fisheries investigations, fishing regulation evaluation on major trout waters. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-28, Job No. II-c. 21 pp.
- Vincent, E. R. and F. A. Nelson. 1978. Inventory and survey of waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-26, Job No. I-a. 24 pp.
- Vincent, R. E. 1962. Biogeographical and ecological factors contributing to the decline of arctic grayling (Thymallus arcticus pallus) in Michigan and Montana. D.S. Thesis, University of Michigan, Ann Arbor.
- Wells, J. D. 1977. The effect of land use practices on trout populations in Rocky Creek, Montana. Report submitted to Blue Ribbons of the Big Sky Country Areawide Planning Organization, Bozeman, Montana. 13 pp.
- White, R. J., J. D. Wells and M. E. Peterson. 1983. Effects of urbanization on physical habitat for trout in streams. Completion report to the Montana Water Resource Center, Bozeman, Montana. 20 pp.
- Wipperman, A. H. 1967. A study of reduced stream flows resulting from irrigation. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-15, Job VI. 13 pp.
- Wipperman, A. H. 1967a. Inventory of the waters of the project area. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-15, Job I. 14 pp.
- Wipperman, A. H. 1969. A study to determine the effects of the mining industry to trout streams. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-17, Job I. 10 pp.
- Wipperman, A. and R. G. Needham. 1965. Inventory of the waters of the project area. Job Completion Report, Federal Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-9-R-13, Job I. 16 pp.
- Zubik, R. J., Jr. 1983. The fishery of Hyalite Reservoir, Montana, with an evaluation of cutthroat trout reproduction in its tributaries. M.S. Thesis, Montana State University, Bozeman. 70 pp.

